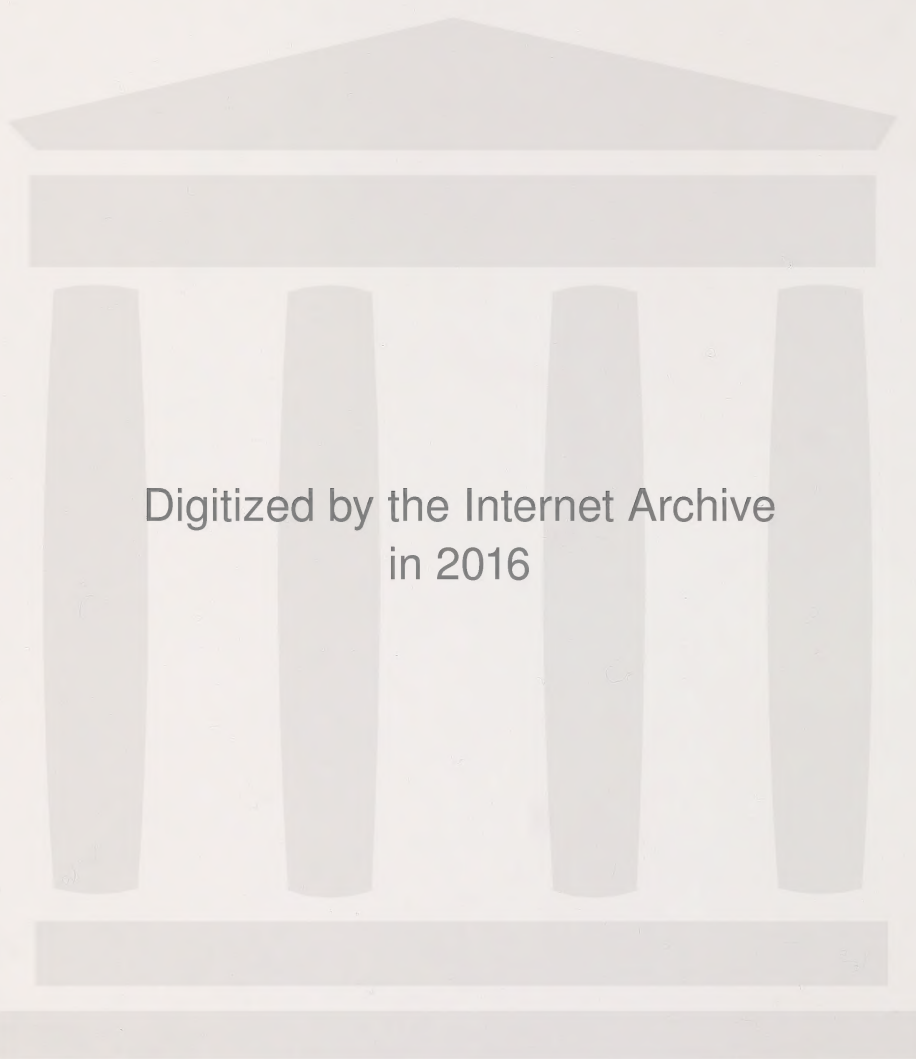

FROM PHANTOM TO FIBRE

R.J. MOORE

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FROM PHANTOM TO FIBRE

Personal Recollections of Telephone Engineering

FROM
PHANTOM
TO FIBRE

Much appreciation is extended to those who have assisted me
in putting this book together to name a few: Dennis Brooks,
Steve Hrynew, Campbell Gibbard, Bob Taylor, John Wade, Peter Schmidt

Special thanks to Alberta Government Telephones for publishing this book on the
occasion of the Canadian Engineering Centennial

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About The Author

Bob started his electrical career in 1937, after graduating from the Institute of Technology and Art in Calgary, where he studied Industrial Electricity and Radio. He then worked three years as an electrician and armature winder for the Parker Electric Co., and Precision Machine Co., both of Calgary. In 1941 he joined the the RCAF and was sent overseas immediately. There he was given training in Airborne Radar at the Radar Training Center, Cranwell, England. On completion of training, he saw service on various night fighter squadrons and Operational Training Units throughout the British Isles. He was then transferred to Tactical Airforce Command, crossed the Channel shortly after 'D' day, and ended up in Germany at the end of the war. He arrived home in 1945 and was hired by the T. Eaton Co. as a radio repair man. He joined AGT in 1947. After a year in the repair shop, Bob was transferred to the newly formed Transmission Engineering Section headed by Russ Crawford in Edmonton. He was assigned to Art Davis, the Assistant Transmission Engineer operating out of Calgary.



Bob Moore showing the model of a microwave system he built. (1972)

In 1960 Bob was promoted to Engineering Supervisor, Transmission and Quality Control, where he looked after a variety of work such as troubleshooting and carrying out surveys and special tests. He retired in 1981 from AGT.

Over the 34 year span of his career, Bob's work gave him a vast knowledge of telephone plant and associated apparatus. It is through this work that he was moved to write a chronological list of stories of telephone work.

He has taken this highly technical subject and pieced it together with happenings of a lighter vein, making it interesting to both the technical and casual reader. It covers the "Magical Era" — 1940 - 1984 — from open wire (including the Phantom), to fiber optics, which uses a pulsed beam of laser light propagated along a hair-like strand of glass to carry messages.

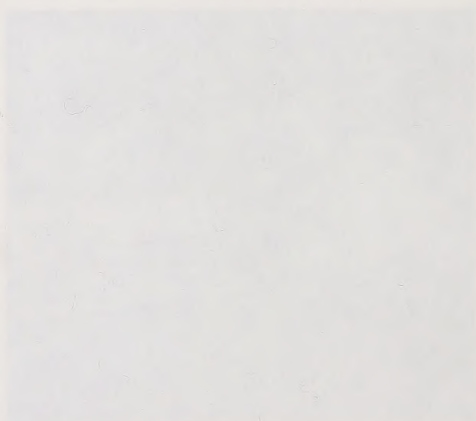
After retirement, Bob felt his experience should be broadened. He went to work for the Alberta Research Council, designing and installing experimental solar energy sites throughout the Province. Following this, he worked in private industry making Animal Tracking devices.

Bob has many things to occupy retired life, and writing has become one of his keen interests. He decided to tell a story of telephone work and his travels of the telephone trail in Alberta, mainly to catalogue the equipment and bring in names along the way, for people of the future to learn, and for those who took part, to bring back fond memories of events gone by.

FROM
PHANTOM
TO FIBRE

*Best Wishes
RG Moore*

This book is a collection of 100 short stories, each of which is a self-contained unit, but they are all linked together by a common theme. The stories are set in a world where the laws of physics are different from those of our world. In this world, the laws of physics are such that the speed of light is not constant, but varies from place to place. This variation in the speed of light leads to a variety of strange and wonderful phenomena. The stories are written in a simple, straightforward style, and are easy to read. They are also very entertaining, and will keep you reading until the very end. The book is a must-read for anyone who is interested in science fiction, and for anyone who is looking for a good read.



The author, standing in a field of tall grass, looking towards the camera.

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FROM
PHANTOM
TO FIBRE

F o r e w o r d

FROM
PHANTOM
TO FIBRE

THE FOLLOWING notes are of 'doings' of days gone by, occurrences that turned work into experiences. Travelling the telephone trails of Alberta took the writer to all corners of the Province. It was a "Cook's Tour" of engineering, inspecting, trouble shooting and POTS (plain old telephone service).

Yes, telephony ... an invention which was at first a novelty, faithfully provides communication for pleasure and business, through years of prosperity, depression and conflict. It is a technology built on sound principles of design and construction, one that has now steered the world in a technical direction to develop new and vivid devices for mankind; thoughts that would have been heresy to dream of in yesteryear.

It is of note that AGT has kept in stride with the industry in its approaches to telephone design and construction, and now even leads the way in many communication technologies virtually

still on the drawing board.

The title I have chosen, *'From Phantom to Fibre'*, exemplifies such a march in communications. The Phantom circuit was an archaic way of achieving one more electrical circuit from a couple of pairs of wires; fiber optics is the new way that transports not just one message, but tens of thousands, using a beam of light propagated along a gossamer of glass. This some day will surely form the basis of major communications networks, bringing full spectrum efficiency, and meet the future requirements of a communication-minded populace.

Telephone circuits, like the spokes of a wheel, extend to the rim of society ... from the cities to the hamlets ... to the rural areas and even the distant farmstead. Each is connected by an electrical thread, creating a vast web of communication.

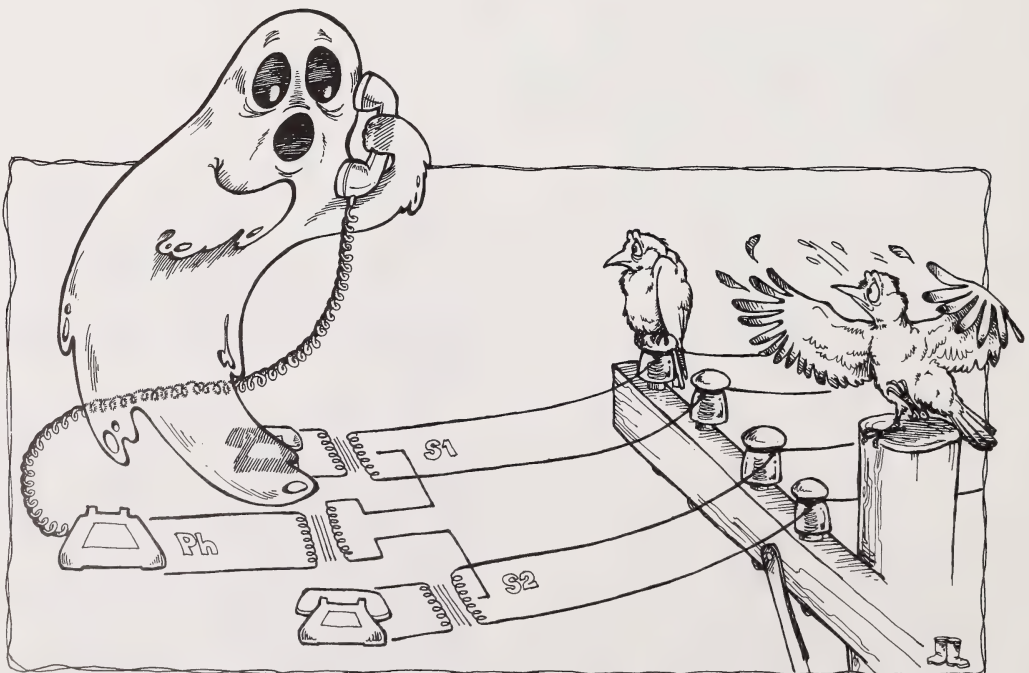
And just think ... most of this has taken place over a short span of fourscore (and a few) years! The spin of a dial or the touch of a finger places a call for a birthday greeting or business transaction, even a message to the moon and back ... a fantastic example of scientific achievement.

Telephone design has likely advanced as much in the last decade as in all the time since those 'twangy' first words in 1875: "Mr. Watson, come here, I want you!"

Many idle hours of travel, sitting behind the steering wheel of an AGT vehicle, prompted thoughts of days gone by, and of the many changes that have come about. It also launched the idea that some day they should be jotted down ... this time has come.

The following chapters embrace an on-the-job account of places, equipment and, of more importance, people. People really put the show on the road: the planning, building and maintenance of the telephone network of Alberta. It stretches from the turtle-backs of the prairies to the wooded bluffs of the parklands, from the shining mountains to the prehistoric diggings of the Red Deer. I have even occasioned a few 'tall ones', of fishing trips along the way, planned while taking some monotonous telephone tests.

After all, are not all telephone guys fishermen?... Or are they just stringers of tall tales?



Chapter 1

The Start of an Era

NO ATTEMPT will be made to go back to the roots of the telephone industry in Alberta; however, I will relate many events and experiences, including a few side trips, interesting happenings and a bit of nonsense which took place over twenty-five years. These stories are mainly about my association with the people of the telephone network, those who contributed to the growth of communications in Alberta. Each is responsible for a gossamer of achievement in weaving today's modern communications network.

The changes fall into technical strata. I attempt to relive the events associated with these changes. These events were just everyday occurrences, but are now "experiences". They have resulted in the cultivation of friendships near and far, and allowed me the opportunity to follow the growth of telephone technology that has clipped along at a panting speed. Early equipment formed the sub-structure of the present network, like the vacuum tube that has been replaced by the

transistor. That antique apparatus, however, served to help scale one ledge on the mountain of progress.

Perhaps it would be best to start back in 1935, when yours truly was a farm lad in the Three Hills district. I got to know Sandy Smith, the local telephone man. Sandy was one of the most popular figures in the area, and usually present at every sport gathering that took place. You see, he had one special interest when he was off duty, and that was baseball. It was at such events that a friendship between Sandy and myself became cemented.

Several years before this, however, a spark flared into electronic dreams for this farm boy — I became fascinated by wireless communication. My interest grew to the point that, in 1935, I had a basic knowledge of radio, garnered by reading every book that I could find on the subject. I learned Morse Code, accomplished by repeating “da dit, da dit ... da da dit da” over and over again while driving an old 15/30 International Harvester tractor pulling a three-disc plough. The old tractor chugged along, spilling out the nauseating smell of good old Turner Valley raw tractor fuel, mixed with the unforgettable aroma of the fresh-turned furrow. With a book propped against the gas tank, I’d spell each word out loud in Morse Code. I’m sure that it would have caused many raised eyebrows and head scratching if people could have seen me.

The only analogy I can think of happened a couple of years previously. It was the case of a lonely character who was checked out by an inquisitive ladies’ group. The guy appeared religiously each evening at eight thirty in a car which he parked on top of one of the hills behind the town. When challenged by the local authorities, he was found to be only practicing the bagpipes. Learning takes many forms.

Anyway, by this time, radio theory was muddling my mind, and talking was coming out in spurts; I had constructed a radio transmitter and receiver. The equipment lacked power, and that was when Sandy Smith came into the picture.

The old magneto telephone sets were equipped with No. 6 dry cell batteries. They were rather cumbersome packages of electrical energy that delivered 1.5 volts (when the zinc case was not leaking) and a healthy rate of amperes (when the terminals weren’t corroded). Using this battery in a telephone set only subjected it to a current drain of about 100 milliamperes. The

batteries, therefore, lasted for months, even years. They would ‘go noisy’ well before their life faded away. It was when they started to go noisy that they were changed to assure quiet, reliable telephone operation.

Now, a little bit of noise never bothered a tinkerer with radio. It came to pass that Sandy, who being the thrifty type had stashed many No. 6’s away, offered these old batteries to me, the young experimenter. It was like winning the Irish Sweepstakes. Immediately all kinds of plans for great electrical experiments began to hatch.

Getting the batteries home was no little chore. The boxes were loaded on a wagon, and with the team of horses I hauled them home over the rutted prairie trail (now a modern highway) to an old building hung with a wizardry of wires and gadgetry. The batteries were still in the honeycomb cells of their original boxes. Each one had to be taken out, cleaned and tested, and the good ones returned to their place in the boxes. Some of the batteries were bulging with old age, some were leaking and virtually cemented together, and others had their brass terminals bashed. Some displayed their large carbon rods through the broken cases, but many appeared in mint condition down to the bright clean label on the side. These batteries were a great source of experimental material — the good ones being used for a power supply, while the broken ones providing carbon electrodes for making carbon arcs, and the zinc for making capacitors and in other experiments. I tried several ways to rejuvenate these batteries. I remember one involving punching the zinc cases full of holes and soaking them in some “magic” fluid (the name of which now escapes me). The next step required heating the battery in the oven of the cookstove. I recall this very well, because the liquid spilled and the next cake took on a strong flavour of Burgess Battery. The law was laid down by my mother — *there would be no more batteries or experiments of any kind in the oven, or the house, or even near the house, for that matter!* Research once more returned to the old granary in the back yard.

Even though I had the batteries, I still required a great deal of “caged up” electricity for lights and the like — my experiments gobbled up power at a terrific rate and I always seemed to have dead batteries. I greatly yearned to use car batteries and to make the wind turn a propeller on a generator to charge these. The filaments of radio tubes were always the hardest on dry cell batteries, and this was the voltage that could be

supplied by a car battery. The filament battery was usually drained very quickly, hence my desire to generate electrical “juice” by wind-power. I ended up with telephone poles all over the yard, each with a big whirring propeller driving some kind of generator. They had no governors or speed control devices. Some nights the noise sounded like a 707 taking off, as the generators whined their hearts out with the wind screaming across the prairies. Boy, did I have charged batteries! I should add that I was always the greatest scrounger, collecting old poles, generators, cut-outs, batteries, ammeters and any gadget that had wires attached.

I spent many nights cleaning and connecting the old No. 6 batteries which Sandy had given me. They were arranged along one wall of the building out back with the rest of the gadgets. Once connected, they powered my Ham Station. Many nodding hours were spent listening to the squeals, screeches, chirps, and crackles of the radio waves, with no interference to the rest of the family. I must confess that the next day furrows ended up rather snaky because of my bleary-eyed steering. I certainly had a power supply that would have been the envy of many an experimenter: several hundred volts with a snarly blue spark. Thinking back, I realize that it was a rather deadly collection of volt-amps; however, nothing too terrible happened, other than the odd startled leap to the ceiling after touching some high-voltage wire.

In 1937, the Department of Transport gave me permission to transmit, and issued me a license and the radio call VE4AJX (now, VE6RM). From then on, I whiled away many hours contacting other Ham Radio stations. It was through this contact with other radio amateurs that the “spark of electronics” in me flared into flame, which was helped by a telephone man who decided that here was a chance to help a young fellow with his career. Indeed, he was right, as I consider Sandy Smith’s help the main reason why I now work in the intriguing field of microwave radio.

From that point, I went on to study more advanced principles of electricity and radio, and to work in these fields. I then spent a five-year stint in the RCAF, where I obtained specialized training in radio and radar. When I finally returned from overseas in 1945, I searched for a place to settle down.

Jack Mulligan was the next person to have an effect on my life.

One evening after my return, I strolled into the

6th Avenue Calgary telephone building when Jack was on duty. I was now beginning to understand what a telephone network consisted of, and I would sit by the hour and watch Jack, Freddie Whiffin, and Johnny Mines, as they ‘routined’ the equipment or explained how a carrier, repeater, Wheatstone bridge, phantom or other piece of telephone apparatus worked. I was intrigued, and felt I must learn more. I decided then that I would someday work on telephone equipment, but it wasn’t until 1947 that I got my chance. At that time, I went to see Mr. Jamieson Sr., the Calgary District Plant Superintendent. I asked him about getting on.

He said, “Moore, there isn’t a chance. I’ve got a whole drawer full of applications.”

I headed for the door. Just as I reached the hall, Peter Kirkpatrick yelled to me, “Hey, Moore! Fill out these forms and bring them back.”

The next week I was taken completely by surprise by a phone call from Mr. Jamieson. He boomed, “Moore, I think I can put you to work. Come down and see me Monday morning.” I didn’t know what to do — I hadn’t expected action that fast, and I had a fairly good job at the T. Eaton Co. doing radio repair.

After giving it some thought, however, I decided it was now or never, so I handed in my resignation (passing up a ten dollar raise) and reported to AGT. It was July 21, 1947.

It wasn’t until I was on my way to the repair shop that I really began to doubt my decision. Mr. Jamieson asked me all kinds of questions, including some about AC theory. He wanted the formulae for things like resonance, impedance, reactance, and other electrical terms. I figured, “Holy Cow! If this is telephone work, I’d better quit while I’m ahead.”

I was given a work bench beside Harold Rix,



The Calgary Repairshop: Cliff Johnson, Bob McLaren, Alf Baird, Al Mayo, Harry Cording. (1948)

who had been hired shortly before me. Alf Baird, the shop foreman, instructed me on the why's-and-wherefores of working at AGT (and why I should join the union), then put me to work.

The main reason for my hiring soon became apparent when I arrived at the repair shop. There, staring at me, was a mountain of new telephone sets, all waiting to be checked out — by me. They were NECo type 300 sets, and believe me, after a few days of setting up dials it was no longer necessary to check on the recorder to determine their speed — I could do it with deadly accuracy, even in my sleep.

It didn't take me long to find out that this Rix was a real character, always up to something. Just for deviltry, one day when he wasn't looking I mixed up the wires on the telephone he was working on. This caused much muttering when he got back. When it dawned on him what happened, he let out a bellow you could hear three blocks away: "Moore, I'm gonna kill you!" It took even less time for me to find my set mixed up in the same way, and I had to spend half an hour sorting out wires. All of this "prankstivity" really paid off in the long run, as Harold and I became most expert at diagnosing troubles on telephone sets and repairing them.

Some of the other people working in the repair shop (located just off 8th Street and 11th Avenue South West), were Dave Cross, Harry Cording, Pat Salmon, Al Mayo, Louie Jensen the carpenter, Bob McLaren and Cliff Johnson Jr.

Alf Baird was the regular shop foreman looking after equipment repair. However, Dave Cross was put in the shop as a temporary foreman to look after the acceptance on new telephone sets (done by Rix and me). Alf wasn't happy about this at all (I liken this set-up to a young bull moose moving into an old bull moose's territory). Anyway, Rix and I answered to Dave, as was to be expected, and it finally got Alf's goat. He confronted Dave with a well-worded statement like: "Who in the h--- do you think the foreman is around here, anyway?" He said he had a few other things he wanted to clear up right then and there. There was much verbal sparring; though it came close, no actual punches were ever thrown.

Each time one of these battles started (just about weekly), all the swivel chairs at the work bench swung squeakily around in unison, and everyone sat there and took in the fun — not even daring to snicker. When they teed off for these bouts, Alf's face would start glowing crimson, starting down around his Adam's apple and

flushing to the top of his head — he was as bald as a teacup. He flared as red as a turkey gobbler in struttin' plume... then he'd start to shout.

Dave chose a more scientific approach, and parried each one of Alf's accusations with beautifully phrased oratory. No-one ever really won — or lost — but, dammit, it was good entertainment while it lasted. They were the best of people, but they had their differences.

All the while, Rix and I kept up our deviltry, as work on that big heap of phones was monotonous. We even secretly put a few faults on sets being worked on by other people, then we'd sit back and laugh our heads off as they tried to figure out how the heck a set could get so tangled up. I don't remember getting caught, and we kept it up for some time.

We didn't take a lot of time to check out all the new sets, and then we were turned back over to Alf. Dave left the repair shop.

One day, Alf called me aside. "Moore," he said, "I'm gonna start you on switchboards."

I thought, "Man, what a break! Those switchboards look like real fun, and will it ever be nice to get away from subsets."

Alf took me into the back room and showed me a large sheet of plywood with a beat-up blueprint of the wiring of a switchboard glued to it. There seemed to be a million lines going every which way. Alf put it on the table and started to give me a fifteen-minute-course in how to wire a switchboard. He explained the circuit by tracing the lines on the print with his thumb. He always used his thumb for tracing the lines on a wiring diagram. I'm not sure why — maybe because it was easier to rest on his thumb when he came to a junction of two lines and had to make a decision about which way to go.

As he started tracing, he was muttering: "OK, Moore! Now watch this .. See how this wire goes up and over, then down here, see? It picks up a con-den-ser, then goes across there... yuh watchin'? Moore!...see how it goes down again and now around and back once more... Moore!...see, there's another con-den-ser..."

It seemed to me that the whole switchboard was full of condensers. They seemed to intrigue the old-time trouble-shooter, and I guess it must have been because he accidentally picked up a charged one some time in his career. (This was, incidentally, another one of Harold Rix's pranks — charging up a large condenser. He'd put it across a six-bar generator, crank like mad, take it off quickly, and put it on Alf's desk. It usually didn't take long for

Alf to pick it up and examine it closely — off it would go like a bear trap. Alf would instantly unleash a flood of oaths, and hop, skip and leap around the room, soothing his thumb and forefinger. Anyway, back to the blueprint).

By this time, Alf had blinked, and couldn't tell where the line he was tracing ended up. There was one thing I knew, though, and that was that way back his thumb covered up a turn and the line didn't go that way at all. A few minutes later, he traced another wire, and once more the line took off at a tangent to his thumb. His thumb slid along slick as heck, but often it took the wrong deek. Alf did succeed in teaching me a lot about switchboards, and I ended up overhauling several. Louie Jensen the carpenter, a true craftsman, finished the boards, and those old 1260's came out sparkling.

I also became interested in another piece of equipment: sub-cycle ringers. I was puzzled how the little boxes could change the 60-hertz mains frequency to a 20-hertz frequency for the telephone ringers. Whenever they came into the shop I would nab one and try to figure it out. One day Mr. Losie, who was in charge of Installation at the time, walked in. I asked him if he could tell me how a sub-cycle ringer worked, or where I could get information on it. He replied, "No, but I'll see what I can do!"

It didn't take him long to bring me a report covering it completely, signed by a Mr. Art Davis. I was really in business then. I took the report home and pored over it page by page. Soon I was sure I could fix the sets without any trouble, and from then on, I was the sub-cycle fixer around the shop.

One day, Mr. Jamieson came in and shouted, "Moore, come in the back. I've got a new piece of equipment I want you to get started on. We're now using a thing called a sub-cycle ringer, and I want to show you how they work so you can repair them."

I replied in a cocky way, "Oh, I know how those things work! I know all about them."

Mr Jamieson never did like wise guys, and glared, "What do you mean? This is a new kind of ringer... you don't know..."

I broke in, "Heck, there's nothing much to those things. I've been doin' them for a long time."

Mr. Jamieson came back, "How did you find out about them? Where did you get the information?"

"Oh, I got a report from Mr. Losie, and I read up on them."

"You what? Where'd you get the write-up?"

"Oh, I went to Mr. Losie...."

"Let me get something straight, right now!"

He boomed, "From now on, Moore, when you want information, you come to Alf Baird or me, understand?"

By now I'd got the message, and I was pretty quiet. I was now doing all of the listening, as he was doing all of the talking. The lecture lasted twenty minutes, and after it finished I had a different view of how things were to be done, and I'd lost a lot of that cocksure attitude I'd picked up. I played things pretty cool from then on.

So much for my days in the repair shop, where I learned the basic principles of the telephone set, familiarized myself with various circuits and equipment, and started to catch on to this new telephone language which proved to be much different from the electrical and radio lingo I had known.

In June, 1949, Mr. Jamieson once more called me aside. I immediately thought, "What in hell have I done now?"

He asked, "How would you like to go and work for Art Davis? He's in Engineering in the downtown office." He continued, "There'll be quite a bit of travelling, and there will be a variety of work to do."

How right he was.

I decided that I might as well try it; I was always game for something new. Almost a year to the day I was hired, I transferred to the Transmission Engineering section in Calgary, headed by Art Davis.

At this time, the Transmission Engineering section had just been formed. It consisted of Russ Crawford, the Transmission Engineer in Edmonton, and Art Davis as his assistant in charge of all field engineering.

I was immediately put to work on many of the studies and investigations Art planned to carry out to improve transmission on the telephone net work. This work included Electrical Protection and the coordination of telephone and power systems. These and other areas of work are carried out today by full-fledged engineering sections employing many people. Some of these sections include: Utility Coordination, Electrical Protection, Engineering Maintenance, Engineering Acceptance, and Transmission Maintenance (Plant Department). Each of these endeavours had their very beginning in this small section of ours, headed by Russ. They have now bloomed, and play an important role in keeping today's telephone network humming and in good order.

Just after I was sent out on the road, I had many reasons to call Art, and even Russ in Edmonton, about problems. I was new, of course, to the work. I ran up such a phone bill that Russ could be heard shouting all the way from Edmonton.

He said, "Enough of this!", and arranged with Mr. Mason, the Chief Engineer, for a telephone pass for me. This was really something. I felt as important as could be — a small town guy with a telephone pass. Out I went, eager to try it. I was at the Hanna office, and ran into a problem: an immediate excuse to call Art.

I rang the long distance operator, and asked her to place a call to Calgary. I said, "That'll be on Pass 123."

The operator must have thought she was hearing things, or there was a joker on the phone, as she repeated, "What's that pass number again, please?"

"Number 123...123," I echoed.

The operator came back: "What is your name? ...I'd like the pass number once more."

I decided no operator was going to give me static, and I snapped back, "The name's Moore! The pass is 123! Please connect me to the number in Calgary that I gave you."

By now the operator likely had all the lamps burning on her board, and she said, "I've got work to do, and I can't waste any more time with you. Your pass isn't 123."

She hung up.

Soon I tried the pass again, and ran into the same thing. There was no way operators were going to fall for that "123" business. I kept trying the pass, but with no better luck. No seasoned operator was going to listen to a strange voice giving her a phony number like "123" — and anyway, most of them knew that the number belonged to the ex-General Manager, Mr. Ferguson. They had not been told that it had been given to a greenhorn named Moore. Russ soon had a letter circulated to the effect that Pass 123 was indeed mine, and at last my calls went through. I kept that pass until 1958.

This, I consider the end of the first era.

C h a p t e r 2

The Utility Co-ordination Work and Electrical Protection

THIS next period could be termed the Rural Electrification or Utility Co-ordination era.

It was about this time that a cry for power was heard from the farms. A program was soon embarked upon by each power company: Calgary Power, Canadian Utilities and the Northland Power Company. It wasn't just the fact that the whole county was going to be electrified that made telephone engineers now sit up and take notice, but the it was the way it was going to be done that caused much concern.

The method (in terms of electrical design) was called the 'Single Wire Ground Return Distribution System'. Power is applied to the circuit by one wire, and the earth is the return path. In other words, the circuit employs only one wire, while the earth takes the place of the other wire, completing the circuit.

Another new demand for electricity sprang into prominence in Alberta at this time: the need for power to drive the large motors on the pumps

in the oil fields. Once more, in the interests of saving money for the distribution system, the power companies used a 3-phase Open Star AC feed. This resulted in high unbalance, with the chance of coupling excessive noise voltages into nearby telephone lines.

Thus was born Utility Co-ordination, which co-ordinated power and telephone network design and construction throughout the province. It established a bond of respect and good relations with the people supplying each company's services. Customers wanted telephones along with electricity, and it was up to us in the Transmission Section to uphold the telephone end of the deal.

Open wire telephone lines are similar in construction to power lines, and are therefore 'sitting ducks' for any high frequency interference (harmonics of 60 hertz) present in the power system. Actually, the power co-ordination problem was two-fold. First, there was the noise interference into the telephone lines under normal power system conditions. The second problem was hazardous 60-hertz voltage that could exist in the telephone lines on heavy AC fault conditions. These would occur, for instance, if one of the high tension wires arced over, or fell to the ground. Art came up with several ideas for measuring these influences.

The outcome of our investigations resulted in various methods for measuring noise and high voltage coupled by the electrical fields of the power wires. These hinged around the use of various types of ground probe wires and antennas placed near or under the power lines to pick up these electrical and magnetic influences.

Art guided the work, as he delved deeply into the mathematics and theories of these electrical phenomena. In this way the basis of Telephone Company policy was formed, whereby a mere measurement of interference would indicate the extent of a noise problem.

Our first job of this type was north-east of Edmonton, at Lamont. I remember this trip, in August 1948, vividly. Art and I placed antennae and probes, then took measurements in co-ordination with Calgary Power load changes.

It poured rain all the time we were out — we plowed mud every centimeter of the way. It was the stickiest, gooey-est mud you ever made contact with. It clung to our gum boots tenaciously, sucking at them, making us lose them at every step because of the weight of the plodding load

of gumbo we carried.

The car got stuck time after time.

We had to cut trees from a nearby wood to use for antenna masts. What a job — lugging those old Jack Pines out of the bush and setting them up to hold the antenna wires!

After taking the field measurements, we travelled to the sub-station and checked the harmonics of the AC Power under various loads and transformer connections. We used our 10A Noise Analyser coupled to the 2B Noise Measuring set. I was really amazed at the way Art rattled off the harmonic frequencies by memory, as I turned the dials and recorded the readings of the Noise Set.

After Lamont, power investigations came thick and fast. It was soon common practice to load up the old '48 Chev 'Panel' and head to some distant cow pasture where a power line tramped along near a telephone lead. The old car was loaded to the hilt with a tent, test instruments, poles, ground rods, sledge hammer, ropes, coils of wire, and — gum boots. Truly, the Noise Set, used mainly for measuring noise and cross-talk, was the instrument of the day. It was battery powered and well shielded, therefore immune to outside interferences. It was heavy, though, and we soon developed muscles like wrestlers. (As a matter of fact all telephone instruments were heavy. That was the way you determined how good they were — the heavier, the better). I imagine the 2B Noise Set paid for itself many times through noise measurement, but it was so versatile: it was used to sit on while taking readings, stand on when you needed a little more height, and so on.

They just don't make instruments like that anymore.

The investigation of power line interference in the Peace River country was a large survey that included many telephone and power parallels. Many locations were selected and readied for the tests.

It was January, 1949, and believe me, darn nippy weather. As a matter of fact, I wouldn't be surprised if it broke some kind of low mercury record. The snow was three feet deep on the level (that was before we got into this metric business). Many of the roads were blocked solid.

I was assigned one of the Power Company's maintenance men, a powerful guy who could use a sledgehammer like a battering ram. He stood on the back of the truck, making its springs sag

to an inverted catenary. He drove the rods into the ground as if they were going into July muskeg instead of rock-hard January ground.

Mr. Warren Dubois was the Northland Power Company engineer in charge of their part of the job. The results of the tests indicated a noise problem that you wouldn't believe. Art and Mr. Dubois went as far as to build and install heavy duty filters in the power feeds, but if I remember correctly, they didn't have a snowball's chance



Field test — Warren Dubois, Chief Engineer, Northland Power Co. (1949)

of controlling that amount of interference. Those old generators cranked out a power wave form more like the shape of the signals of a pulse code modulation signal, when they should have been nice and rounded and 'hummy' like, not a raucous buzz. Art and Mr. Dubois worked on the Peace River system for some time before a half-decent power/telephone compatibility picture could be presented.

Another personality who sticks in my mind also took part in the tests that winter. He was the Northlands Utilities man in charge of the McLennan generating station, a guy who was six foot four and muscled out to around 250 pounds. He couldn't have had any other name but Tiny.



McLennan Power Station: Northland Power Co. (1949)

This particular power plant had a huge diesel engine that was started by an air compressor. The air compressor was driven by a big gas engine. This machine had a fantastic bore, and a flywheel so heavy it would continue to spin for half an hour after the petrol was shut off. It had a crank long enough for two men to hold on to. I tried to turn the engine over — heck! I could even stand on the crank and it wouldn't budge. When Tiny came in to start the compressor engine he merely reached down with one hand and spun the crank like he was winding a toy car while I stood bug-eyed and watched. The townspeople mentioned other herculean feats that to him were just daily routines. It's hard to imagine the destruction he could have caused if he ever got mad, but he always seemed friendly enough as he went around with a big smile on his face.

One more job cropped up the next spring at Crossfield which too required a field study. It also had to be co-ordinated with the Calgary Power Company. The work was slated for a Sunday, when the power could be turned off



Crossfield utility co-ordination tests: Art Davis, Ted Girling, Jack Newby (Calgary Power field engineer). (1948)

throughout the district. One of the tests was to determine whether the noise in the telephone lines was being caused by the generators, or large induction motors, or overloaded transformers throughout the network.

It was decided to remove the farm electrical loads at the sub-station and connect a large 'resistive' load in the form of light bulbs. To accomplish this, a great number of high-wattage bulbs were mounted on several boards, connected in parallel, and fed by a transformer. This was all arranged by a Calgary Power engineer.

We got our paraphernalia set up at the same time. It didn't take long before all was ready for

the count down ... the 'disconnects' were pulled one by one at the sub-station ... then the big knife switch connecting the lights. There was



Crossfield: Lee Harrison, Art Davis, Jack Ford (Calgary Power). (1950)

a blinding flash like the takeoff of a flying saucer! It dimmed the sun, then all the lights went dark.

Every bulb now encased a drooping glob of molten filament — not a glimmer of light to be seen. Each suffered an Ohms Law ailment caused by a lamp filament without enough resistance for the voltage applied. It was a case of applying 440 volts to 110 volt light bulbs. When this happens on a Sunday, there are not many replacements around. All was not lost, though, as we were able to carry out several related tests.

Other power co-ordination jobs were soon carried out at Milk River, Fort MacLeod, Stettler, and Smoky Lake, to name a few places. We soon had a good idea of the TIF (telephone influence factor) of most of the AC power systems and the telephone line coupling, and therefore knew the separation to allow between power and telephone lines. We quickly got to know the type of field measurements to carry out for reliable information about a parallel.

So much for the interference. There was another problem that Art was very concerned about. This was the protection of telephone equipment and the people using it when a power fault might occur. Excessive electrical currents flowing in the ground could induce hazardous voltages in the telephone lines. Protection required knowledge of earth resistivity and coupling impedances. Many earth resistance measurements were needed for these calculations, and these brought about a thorough acquaintance with the good old earth megger. I remember this instrument well, because you also had to take along three ground rods, a big

roll of wire and a sledge hammer. Readings were taken using probes connected to the earth by ground rods.

The worst case of voltage coupling was found in the 'gap' near Exshaw, a region where the power and telephone lines snuggle up pretty close to squeeze through the narrow pass in the mountains. It was a bad case, aggravated by the fact that the earth resistivity was high (loam came in the form of gravel). As a matter of fact, we suspected the whole open-wire lead from Cochrane to Banff of having excessive coupling.

Anyway, Art decided to check it out. He assigned the job to a young engineer by the name of Lee Harrison, who had recently graduated and been hired on with AGT. He'd been assigned to our field force, bringing it up to three men.

Another name that comes to mind from that time is Norm Blamire, an Englishman fresh off the boat from the land of mussels and cockles. He, too, had just come to AGT and was working for Russ Crawford in Edmonton. Russ had a flair for the practical side of things. I imagine, too, that he figured any green Englishman should have his corners rounded off, so he decided to send Norm out to see some real live telephone plant before settling him into an office job. Norm was thus sent out to help Lee and me with the Cochrane-Banff high voltage induction survey. It required accurately measuring the distance between the telephone and power lines at each place where there was a change in the relationship of one line to the other, and mapping the configuration of each.

Off we started with transit, survey rod, note books, maps, mosquito lotion and — gum boots. I'm sure we must have looked like Lawrence of Arabia, especially when we cautiously started across the Morley Indian Reserve.

Norm proved to be a likeable chap with many great tales of achievement. I figured he was a bit of a bragger, though, as he periodically related to us that he was 'God's gift to the Canadian girls'.

Now, there we were with Norm, in the dead centre of Indian country at a place somewhat hilly and rocky, where nothing grew except a sparse covering of Prairie Wool, Russian Thistle, a few cactus, and the odd tumble weed. The terrain was Swiss-cheesed by a great influx of gophers and bright eyed badgers. Lee decided that this was where a measurement was needed.

Actually, we'd been kidding Norm quite a bit. We said, "Man! There's gonna be rattle snakes



and coyotes out there...we'll have to go deep into Indian territory, and who knows what might happen there? Those redskins have had all winter to sharpen their arrows and haven't forgotten the dirty tricks that were played on them in days gone by ..."

Well! You can imagine we'd worked Blamire into a terrible fidgety state, but he was undaunted. He had come prepared with snake bite remedy, high boots, and running shoes.

He kept a watchful eye on the horizon, and the least yowl in the distance brought a vertebrae-snapping turn of his head to scan that direction with a pair of very concerned eye-balls. Anyway, the work went along very smoothly under Lee's guidance.

On this particular day, we headed across the wilds to a spot where the wires looped jauntily over head. We started to set up the transit ... just then a herd of cows headed our way to inspect our goings-on.

Lee let out a bellow — "My Gawd!" he roared, "There's a big rangy bull over there an' he's pawin' the dust."

At that moment there was a commotion like a top that had been ripped into motion by a cord. It was Norm — he'd spun on his heels and was clearing the turtlebacks of the prairie at a terrific rate.

He'd dropped the rod, clutched his hat, and he tore along at a speed that would make the lankiest coyote envious. He was completely 'unnerved, but unswerved' in getting out of there.

I know that of all the medals Blamire claims

to have had bestowed upon him, there is another... for a record streak across the Morley Indian Reserve. And another thing, I'll bet that damn ol' bull died with bloodshot eyes from laughing at Blamire's gallop across the cactus-studded prairie. Lee's laugh resounded for a full ten minutes, echoing through the hills with a hilarity only he could turn on.

The survey that summer offered an opportunity to view the world's best scenery and tramp through the intriguing foothills of the Rockies.

At one place we came across an old Indian encampment with ritual stone circles; at another, we saw the work of beavers and woodpeckers, one of which had made a mighty fine home in one of the huge power poles. We saw many wild animals, birds and flowers, and had fantastic views of the Rockies ... it was truly a summer indelibly etched in memory.

The survey finally ended, and Lee decided on a location near Exshaw for the installation of the protective short-circuiting relays. The problem after that was to get a low resistance earth connection to make the relays effective. This meant driving many ground rods — but then, that's another story.

Part of our work in connection with Utility Co-ordination was looking after the electrical protection of telephone equipment and the people using it. For this, various types of electrical protection methods were used. They were connected to various telephone installations, equipment racks and power poles. It was the engineers' job to approve the protection equip-

ment and methods, and investigate cases of damage caused by electrical discharge.

One place where concern 'zoomed' was at electrical power sub-stations; at these locations a good connection to earth is necessary for the high voltage distribution system. It is therefore the place where large amounts of alternating current flow. When this happens under fault conditions, such as an arc-over or a line break allowing a wire to fall to the ground, complete electrical saturation of the surrounding earth exists. It must be remembered that electrical current flowing through soil, which is really resistive in nature, causes a voltage to rise across it. This is the old electrical law whereby *Voltage = the Current multiplied by the amount of Resistance the current flows through*. When current is exceptionally high, as at the time of line fault (in the order of thousands of amperes), the voltage then becomes of similar magnitude. The crunch is that such a voltage can easily exist between a sub-station and a telephone a few miles away. The sub-station literally sits on a 'potential hill' while the fault lasts, and may be lethal to people using the telephone at that time. Keep in mind that the telephone set is also grounded through its protector (98A).

The whole thing required study, which brought Bob Sutcliffe onto the scene. Among the various things he studied were ways and means of providing protection for telephones installed at power company sub-stations. The solution to the problem was to use what is called a 'neutralizing transformer'. This is a transformer containing three windings on its core. One winding is grounded at the sub-station and its other end is extended by cable pair to a ground connection at the distant telephone set. The telephone line (tip and ring) at the sub-station is in turn connected to one end of each of the remaining windings.

The local sub-station telephone is connected to the other ends of each of these windings, through, of course, standard fuse and carbon block protection. Any sudden rise in voltage between the two distant locations due to power line fault causes an opposing voltage to be induced into the two transformer windings connected to the telephone. This greatly reduces any hazardous voltage between the distant sets.

Soon Roy Watts took over the job from Bob. Roy started off on a campaign to show farmers the effect of high voltage and what could happen if telephone and power wires got tangled. He figured this was wise, as farms were



Edmonton: Roy Watts. (1964)

becoming electrified and the farmers all had telephones. There was also a lot of 'joint use', meaning that power and telephone lines shared the same poles. This added the chance that wires might somehow touch each other. He devised various demonstrations to get the point across: some showed protectors vaporizing and going up in smoke. He even used wieners to give off a real live odorific sizzling effect. He also used a 'Jacob's Ladder' to present a fiery demonstration that made any doubter gasp, put his hands in his pockets, and edge back.

Roy did a lot of study on various protectors. The 98A was quite standard, with voltage to ground protection from about 350 to 570 volts. It included sneak current protection for each wire, using 5 amp fuses. These were long fuses to prevent arc-over. Another voltage protector that was pretty well standard was the 99A, used to prevent the 98A from arcing if the power line accidentally contacted the telephone line.

Since a protector without a good ground has very little effect, Roy decided to have the earth resistivity measured throughout the province. For this test he had about 50 ground rods driven into the ground at various places, then made measurements at each site every couple of months. Results indicated that 6 foot rods were not very reliable, which led to a standardization of 8 foot lengths.

He also wore another 'hat', that of Utility Coordination, as there was still great concern about the never-ending noise influence of power lines. This concern led to a search for apparatus for determining the location of buried cable, which also brought about considerable lab testing of many gadgets put on the market for such use.

Another application for the cable finders was determining the location of pipe lines, as cable plows and a gas line are not good companions. On one or two occasions, there was a fine fiery display when a plow tangled with an old pipeline that was not marked on a print.

I can only think of one or two cases where an accident occurred due to conflict of power and telephone, and I feel this speaks well of those responsible for the protection of telephone equipment.

Electrical protection is still carried out by a full fledged section. They use modern approaches and deal with many new applications where extremely high voltages are employed by the Utility Companies.

*The Utility
Co-ordination
Work and
Electrical
Protection*

Electrolysis

THERE are two types of electrolysis. The first is caused by true voltaic action. This is called electrochemical corrosion, and is a problem usually confined to small localized areas. Nonetheless, the attack can be intense. It usually takes place where metal is immersed in salt solution, and may be caused by the metal's oxide or scale and a salt solution. Battery action is set up, causing pitting at the point where the electrolytic action takes place. This form of electrolysis creates trouble mainly with oil pipelines and underground water pipes.

Another kind, and of a more serious nature as far as telephone people are concerned, is caused by heavy DC currents associated with street railway systems in cities. Normally the transit electrical systems are designed to use a heavy gauge trolley wire to carry current to the distant street car, then to return the current by way of the steel rails lying in the ground through wheel contact with them. This is all well and good when the railway system is new, bright and shiny ...

but when it is old and rickety, when connections (where one length of rail butts up against the next) have deteriorated to become highly resistant to the flow of electricity, then the electrical current dives off the rail into the ground and on to some iron water pipe or our lead-covered telephone cables. That's OK — it's where the electrons slither off back to the ground that damage is done. At this place the 'solid little citizens' cart away great quantities of lead. It isn't long before beads of water ooze through holes in the sheath through the insulation to the copper wires. When this happened, little time passed before the local telephone switch board lit up from top to bottom with irate customers telling the operator what she could do with AGT's noisy telephone circuits. That stray 60-hertz, and all its gleeful harmonics, made the most musical sound in a telephone set that you could imagine.

Speaking of stray 60-hertz currents, I firmly believe a person could go to the remotest part of the Arctic, drive a ground probe into the tundra, and with an earphone connected hear power line hum. I believe we surely must have polluted the entire globe with stray AC power line frequencies.

Anyway, in one particular case, Art called upon Lee to investigate a Calgary electrolysis problem caused by those heavy DC railway currents that were creating holes in the telephone cables. First, something had to be done to determine how bad it was, then a way had to be found to prevent it. There was one thing for sure — the City of Calgary wasn't going to do away with the street car system for some time.

Once more Lee donned his field boots, tucked his slip-stick in his hip pocket, picked up a clip board, looked for a pair of size 10 gum boots, and summoned me to help ... we were off to fight the electrolysis monster. Lee decided to first take an 'electrical audit' of the cable system from an electrolysis point of view. It was mainly in the downtown area, and was accomplished by measuring the voltage to ground of all cables in the manholes, including a voltage measurement along a length of cable. This allowed us to calculate the amount of 'sheath current' flowing in the cable; the voltage to ground indicated likely trouble spots. Lee and I climbed into every manhole in the downtown area at least half a dozen times before the survey was over. By the end of the survey, could we ever yank those manhole covers off.

Actually, the electrolysis work started a couple

of years before this, at a time when I first reported to Art. Art and I went out to look at a place where he'd suspected stray DC currents on an overhead cable, and so decided to make a few measurements. I noticed that he'd brought along pole-climbing gear and I remember thinking, "This guy Davis is sure 'an all round engineer'. He's a whiz with a slip-stick, knows all about electrical power stations, can handle any problem in radio, telegraph or telephone, and what the heck! It looks like he even climbs poles."

I had a surprise! I was not quite right on this last assumption.

When he arrived at the pole, he turned and pointed, "Bob, get your spurs on and connect these test leads between the cable sheath and that messenger wire."

This instruction shook me like a Joe Louis punch ... what the heck did he mean — MY SPURS? Well!

It took me 15 minutes to get the first iron on. By the time I was completely 'spurred up' I was trembling so badly my eyesight was blurred. Somehow I clawed my way to the top, not at all graceful, nor by approved method. I know one thing for sure: to this day you can find my fingerprints in the steel messenger at the top of that pole. By some miracle I made my way back to the ground, none the worse for wear. I now have a firm conviction that high riggers should be the highest paid people in the world.

After that, anytime I saw Art heading for the field with a pair of 'hooks' under his arm, I suddenly remembered something that had to be done in the office. Climbing gear and I never did get very friendly. Actually it wasn't the height that bothered me, but my knees knocked together so hard that I couldn't keep the gaffs in the pole. And too, I found that I couldn't release the bear hug I had on the top of the pole to reach down and snap my belt in place.

Electrolysis finally took us to many other places in the city. If we weren't in a manhole, we were up a ladder checking some lead cable or an anchor rod connection. We crawled into every manhole in the downtown area, and by autumn we had arms like gorillas from taking manhole covers off. We could hit that little square hole in the lid with deadly accuracy, then with a flip of the 'pick', yank the cover off and over to the side.

I remember one case of electrolysis that cropped up on a new cable installed between Center

Street and 4th Street East in the lane between 7th and 8th Avenue. The following spring the cable had to be pulled out because it was so badly pitted by electrolysis, it hadn't even been spliced in for service. It must have had electrical contact with other DC-laden cables.

Yet another case of electrolysis happened near the fire station on North Hill, just west of Center Street on 16th Avenue. At this location the anchor rods on an overhead cable would last barely two years because electrolysis aggravated the ground corrosion which occurred just at ground level, making the ground rods break off. We found considerable DC voltage between rods that were even a short distance apart.

One day in April 1951, I was busy measuring sheath currents on cables in a manhole located in a school yard just off 9th Avenue in East Calgary. I was trying to relate the current in the cable sheath to the effect of the street cars passing nearby. Each time a car passed, I quickly recorded the current and the time and direction the street car was going. I was quite occupied taking the readings when a shadow was cast across the top of the manhole. I looked up and saw an elderly character dressed in the best hobo attire you could imagine, complete with a willow walking cane, bed roll, bandanna, whiskers and small black mongrel that balanced on the edge of the manhole and peered down yapping.

I was about to tell him and his hound to scram when he broke in, "Whatcha testing, Mister? Looks like ya got electrolysis trouble, eh?"

He shinnied down the ladder and knelt beside me, then went on to tell me about electrolysis, what caused the damage, how it acted, and what to do about it. He had a lot of interesting theories and ideas.

After about an hour he got up, struggled back up the ladder, picked up his belongings and headed off.

"C'mon, hound ... see you," he waved.

After the survey was completed Lee went into an analysis huddle with me, and he decided on two courses of action. The first was to install 'insulating joints' in the metal sheath of cables that indicated high current; and the second was to install forced drainage. This is the installation of low resistance copper wires reaching from the street railway rectifier-ground terminal to some remote connection on the telephone cable sheath. The 'insulating joint' in the cable sheath provided a break in the electrical path, so the current could be routed to areas for its control.

The forced drainage made sheath currents

return to the rectifier by a copper conductor, thus avoiding electrolysis action on the cable, as would be the case if the current dived off and returned by the earth. In effect, it extended the rectifier negative field metallicity. One precaution was necessary: to make sure that the cable was not made too negative. If it were, it would attract every 'home-coming' electron in the country, even from water pipes, gas pipes, sewage pipes, buried bed springs, old cast iron bath tubs and who knows what! The electrons would then likely cart off bits of iron and all kinds of metal in their bee-line through the ground to our highly negative telephone cable. This wouldn't make the Utility Company people happy at all — the earth would soon become very soggy from water which they thought was turning a meter but instead was spurting out at some underground artesian.

Well, we kept the electrons sneaking home at a fair trickle by forced drainage. I'm sure it did a lot of good controlling electrolysis of the cables, as the troubles seemed to diminish. Lee designed the control panel, and I procured the parts and built it. Then I installed it in the #5 Power Sub-Station located on 6th Avenue East just off Center Street. It consisted of a piece of asbestos board on which was mounted large DC valves (a form of copper oxide rectifier), a large AC ammeter and several big strappable high wattage resistors. All of this was connected in series with our return wire, then to the negative terminal of the 500 volt street railway rectifier. After installation, I monitored the panel monthly to make sure all was in order.

I really felt pretty important working in that Sub-Station, near the huge current-regulating transformers with their floating secondaries, the meter panels, shiny knife switches, brilliant glowing mercury arc rectifiers and copper busses carrying huge quantities of electricity.

There was always a great chorus of musical tones from the 60 hertz frequency, and all of its harmonic relatives ... they rattled away on some loose transformer lamination. I always felt awed by giant installations at power stations which carried the air-crackling power. It seemed to give me the feeling that the high voltage was just waiting for a chance to jump at me — it made me sneak by edgewise with both hands in my pockets. Also, the humming chorus told me there just had to be life within those steel cases.

As previously mentioned, when electrolysis eats away lead so that a hole is made in the

sheath, an electrical path is then created from the ground to the conductors within. This allows a sneak 60-hertz alternating current to enter and certainly makes line switches in the telephone office rattle. I saw this happen once in the Calgary East exchange office. Doug Thompson was in charge at the time.

The whole place was a hornets' nest as the line switches leaped up and down and buzzed away. Art and I found the cable trouble after much carting of test gear from place to place, and we finally returned the office to its peaceful clickety-click state.

Although electrolysis is no longer a problem now that the street railways have gone and their steel tracks are no longer used for circuit return of electric current, (and too, we now use plastic-covered cable,) it was nevertheless of great concern to us in those days gone by.

Electrolysis

Sub Set Testing: A Need for an Artificial Ear and Mouth

AROUND 1950, the need arose to test the electrical characteristics of subscriber telephone sets. It was brought about because we were being deluged with salespeople from various companies, each claiming that their sets had the best performance and most features. Art decided that we needed something to test them with, something that would be better than just listening to, and looking at them. Even a comparison with another known set would be better than what we were doing. He came to me with an idea: I was to construct an acoustic box, place a 'pick-up' receiver opposite the set's transmitter, then we'd send signals into the set under test and measure its response. We'd then compare the results to a standard set we'd adopt.

I went ahead with the box, arranging the sending and receiving inserts on swivels so they could be adjusted to the required angle and spacing. I then mounted a panel with switches to choose either test conveniently. Next, there was a battery bridge, like the circuit of a connector, along

with a 48-volt power supply and an artificial line that simulated various lengths and gauges of cable. All the equipment was connected to an audio oscillator, a 2B noise measuring set, a volt — meter and a milliammeter. I then selected a standard of comparison. Since the NECo type 300 was widely used in AGT at that time, it was chosen as the set to compare the others to. I went to the equipment stores and loaded up a hundred telephone sets, hauled them to our back room lab, and went to work selecting a couple of sets of average all-round performance.

After about three weeks of reading dials, comparing results of transmission, side tone, ringing characteristics, and so on, I practically saw telephones in a coloured nightmare. Eventually I found two sets that could be used as a standard — I splashed red paint on them and put them on a shelf.

Testing subsets provoked much thought about what goes into a telephone set, and the history of such things as the '144 transmission weighting'. This is a response curve that was chosen from millions of subjective tests conducted at the World's Fair in Chicago in the 1930's. Telephone booths were set up for this purpose, and people were invited to register their opinion on things like frequency response, loudness, effect of noise and numerous aesthetic properties of telephone sets.

Our efforts to evaluate the sets were based on this crude measuring set-up. It offered a degree of evaluation strictly on a comparison basis with the NECo 300 set we'd chosen. Later on Bob Taylor became seriously involved, as he was in charge of trunk design and wanted a more precise system for evaluating subsets. It was the Swedish Ericafone that finally brought things to a head. Ericafone representatives were trying to interest AGT in this 'cobra' style telephone set used across the pond, claiming great advantages. Finally Bob decided on the Bruel and Kjaer test equipment — a very sophisticated lab-type assembly of apparatus. (Incidentally this equipment still sees use in the AGT Engineering Lab, with a similar set-up in the Quality Assurance area of the General Services Repair Shop in Calgary.)

I should mention another fairly effective test used in the Repair Shop during the days of the old 'Oak Box' magneto sets. Just before the set was sent on its way, the repairman merely took the bell-shaped earphone off the hook and held it in front of the mouth piece (transmitter). This caused the set to break into a musical howl (if

it was working) because of the feedback. If the set was not working then no howl would be heard. It was a quick check of the 'gain' of the set and that's what counted — nothing was checked as to frequency response or the like — as long as you could get that tinny talk-signal across, it was really all that counted in 'them thrar days'.

The sub set program has come a long way. Now the sets have changed. They use an improved frequency range — still 250 to about 3000 Hz — but of a more even distribution. This curve is called the *Weighting Response* of the set. Subsets also have internal networks now that automatically adjust the transmitter current so that the same value exists, regardless of the distance of the telephone set from the exchange office (its source of voltage). The guiding light behind this very large sub set program (new and repaired) is the Quality Assurance tests carried out in Calgary Repair Shop under Ted Hulbert's eagle eye — and kept in line by Peter Schmidt of the Transmission Engineering Section. Once more, it all stems from the meagre efforts of our Calgary Transmission work with a home-made acoustics box for testing telephone sets.

Let me stray to mention an interesting telephone set and a use we put it to. The Federal set was introduced to AGT in 1952. It was arranged so that it could be mounted on a wall or used as a desk set. It was a magneto set, and gave a lot of problems, mainly because of the poorly constructed hook switch. Bob Taylor and I had started a great deal of cable testing about this time, and we needed communication between the two ends. Bob decided that the Federal set was well adapted for this, and suggested fixing up a couple for this purpose. I put a 'drawer handle' on the top and mounted binding posts on the front for line connection and the battery (two No. 6's). With a strap to hold the handset in place, we were in business. The set was compact, had a good little magneto, and real good signal output. We were able to communicate over long distances, and although it became defective the odd time — always coming to life when given a sharp jolt with the toe of a boot — it worked very well for end-to-end communication when testing open wire or cable. Prior to this, we'd built numerous 'Butt-Ins' for communication purposes, but these had poor volume, no bells, and no magneto for signalling the far end. The Federal sets worked much better, and to my knowledge are still going strong.

We certainly had a variety of telephone sets

to work on. These ranged from the modern NECo types to sets in the old oak boxes. I fixed many of these when I worked in the repair shop, as we looked after the repair for many rural telephone companies. About the only thing that ever happened to these antiques was broken wires. The inside wires became as brittle as packaged spaghetti and snapped at the least provocation. Batteries were also worthy of test; when the door to their compartment was opened, many were bulging and soggy. The old magneto, dependent on the prime mover of a well-cranked arm, often developed weak magnets — for this, we had a large magnet charger. We'd place the weak horse-shoe magnet across it and throw the big knife-switch; it would snap its laminations together and gather up all the iron fillings around, then settle down to a gentle hum of rectified AC. It used to be a contest of strength around the shop to try to pull a magnet off when the 'juice' was on. When an old-timer talked about his telephone set he did so with pride — it was the number of horse shoe magnets that it had — a sort of status symbol. A '5 bar' just had to be better than a '4 bar'.

The old magneto set, which matched the 1200-type Magneto Switchboard, must always be considered as one of the big steps forward in telephony. It fulfilled many requirements. It came into being in an era when there were few radios and no television sets. Roads were little more than trails. Schools, towns and neighbours were scattered far and wide. There were no supermarkets, fancy drug stores and few forms of entertainment, but people had their rural telephone. It was used for business, socializing and amusement. It's hard to say where the term '*Rubbing*' came from, but the old magneto set certainly was put to good service in keeping track of the local gossip. It worked over most adverse line conditions, in some cases even when an enterprising farmer saw fit to route the wires by way of 'barbed wire' to give him a quick opening for his threshing machine. The old telephone had no complicated parts. Wiring was easy to trace and everything was in a beautifully finished oak box. It certainly deserves a spot in that Hall of Fame for equipment that started with those historic first words: "Mister Watson, come here. I want you".

Each magneto set was connected across the wires of the pair (tip and ring). There could be ten to twelve sets, depending on the length of the open wire lead. Signalling to the operators was between the two lines and ground. At the switchboard end, a small device called a 'jack and signal' indicated the line being called in on. To accommodate this, a button had to be pressed on the side of the box while the generator crank was being turned. Signalling to another subscriber on the same line merely required cranking — for instance, a long and two shorts. The operator was referred to as 'Central'. She answered by placing the plug of a cord into the calling jack, and at the same time restoring the flapper to its original position. Then she answered the party.

The operator's assistance to people of the district is a story that has been told over and over; her service, interest, and devotion to duty is unmatched. Remember, it centers largely around the old magneto sets, and the companion magneto switchboards. I worked on many jacks and signals, restoring them to good operating condition, while rebuilding magneto switchboards. I also learned a great deal of basic telephone while working on these units. It was to my amazement that I learned that the permanent magnet in a receiver served the purpose, among other things, of preventing the sound coming out an octave higher in pitch, as it would if a magnet was not employed.

It is interesting that even today old magneto sets still adorn the walls of many rumpus rooms. Even in their dormant condition, they enjoy a special kind of prestige all their own. Some of the old names include Kellogg, Stromberg Carlson, Western Electric, Automatic Electric, and Siemens. This equipment didn't always come in an oak box, but it did seem there was an abundance of this sturdy wood that was made into boards just for telephone equipment. Note that one thing hasn't changed about the use of the telephone since "Day One" ... most of us still answer the phone by saying "Hello."

Radio for the Roving Vehicle

IN 1948, Russ and Art decided something had to be done in the mobile radio field. The need was growing rapidly, mainly because of the many new-found areas in the province that were starting to seep oil. Construction crews working in the oil fields needed transmitter sites for communication and, as AGT was in the communication business, it became our job to do something about it.

As a result, Art and I headed out one day in old #44 to check out the situation. After about a week of maneuvering around the hills and dales of central Alberta, we returned to Calgary with ideas for making radio path tests to determine how good the coverage was for radio signals in the 156 mHz band. Art's first step was to phone Mr. Munro of General Electric and arrange to obtain a couple of 157 mHz radio transceivers. Art told me to pick them up, along with a number of parts from Smalley's Radio, including a microammeter, resistors, capacitors and the like. Just as I walked in with them, Art handed me

a wrinkled piece of foolscap and said, "I want you to modify the sets like this! Make these changes and then take calibration runs on them." It took about a day to make the modifications and check each one out, then I ran the calibration curves he wanted.

The next procurement was a couple of steel masts, guy ropes, anchors and a lot of other paraphernalia like a tent and — gum boots.

Art arranged for extra man-power to erect the mast, including Norm Blamire, Joe Sherrin Jr., and Archie Hollingshead (when we were in his



Norm Blamire, Joe Sherrin, Archie Hollingshead, Art Davis. (1949)

area of Athabasca). We also had a couple of people from the heavy gang.

Because the Innisfail-Caroline path was the first to be tested, we headed for Innisfail, planning to do the Westlock-Athabasca route next. The survey went along without a hitch. We'd erect the mast with an omni antenna on top, and Art would travel around the country to the many



Innisfail: tent and test equipment for 156 mHz radio path testing. (1948)

high places which he'd located on topo' maps, taking signal strength readings. I stayed at the other end, at a place where we'd put a tent

for the test equipment (and me) in case of rain. Our power was by way of a small gas-driven 110-volt AC plant. I sent Art test signals whenever he made contact with me. On some occasions he'd drop into a blind spot behind a hill. When this happened his signal became barely readable, and certainly no voice communication was possible. For times like this, I rigged up an audio oscillator and connected it to the transmitter, then sent Morse Code. As both of us were Amateur Radio Operators, using Morse Code was old hat, and saved the day on several occasions. Art's survey soon determined to a large extent the kind of 150 mHz coverage to expect for mobile radio use.

At one site, we'd just finished setting up the mast and were in the process of guying it, when all of a sudden a whirlwind roared by. The mast began to shake, and rhythmically swayed as if it had a hula hoop around its middle. It buckled, and down came 50 feet of steel mast with a shuddering clatter. Jeez, everyone streaked out of there like mad in every direction.

When the dust cleared, we found the antenna on the ground, looking not too unlike a heap of day-old spaghetti. I guess Art had figured on something like this happening sooner or later, as he had brought along a spare. We took it down from the top of the car and put it up without further problem. We certainly became expert at erecting steel masts with gin poles and guy ropes, a couple of prayers and two or three choice words, by the end of the survey.

After the Caroline tests, we moved on to Athabasca as planned. After erecting the mast on a hill just south of town, we set up the tent, fired up the equipment, then Art took off. The tests here, however, did not come up to expectations — the coverage was not good at all. We decided to take the mast down and move to another site, thinking it might be better to test from the Westlock end.

As I recall, to the best of my ability, Art got a bright idea along the way: "Why not use the top of a grain elevator for the antenna? It would be higher, and save the time of putting a mast up." He decided on the town of Clyde, not too far off the highway. It had several grain elevators, any of which would do the trick.

Art got the OK from the elevator man, and we unloaded things and started the job. The antenna was to be mounted on a short stub mast that would stick out the trap door on top of the cupola of the elevator. The antenna feeder was then to be pulled up by rope and connected to

the antenna, with the bottom connected to the radio equipment in the truck. From the ground, that elevator looked like a skyscraper — from the roof, it must have looked like a mile to the ground.

Just then, Art took out a battered 2-bit piece and muttered, “There’s only room up there for one of you. Let’s see who it’s gonna be!” He continued, “Tails, it’s you, Norm, and heads, you,” pointing to me. He flipped the coin in the air and it landed on the ground, rolling near his boot as it settled in the dust, with the tail side showing.

Norm glared and grumbled, “You bl---- Canadians, you keep pickin’ on me!”

Anyway, he got set for the climb. The trip to the roof was by way of the shaky “manlift” normally used by the elevator attendant, then a 15-foot climb up a ladder nailed to the wall, leading to a trap door on the roof. Art and I went back down the road so we could see up to the roof. We waited and waited. Then, just as we started back to see if Norm had got tangled up in the ropes, the trap door opened and out stuck Norm’s head. He was in a terrible state: coughing, sputtering and clawing for fresh air. He looked like a big woolly snow man, except instead of snow, he was wearing a thick coating of barley dust. Apparently each step of the ladder had a 25 year build-up of dust, he said afterwards. When the hoist motor started, it fanned up such a storm that he thought he was in the Sierra Desert. His eyeballs had a thick scratchy coating; it was so bad that several times he had to stop climbing and try to suck in filtered air from inside his coat — he was completely covered with dust from head to foot. Eventually, he hauled up the antenna and fastened it in place, hauled up the co-ax and connected it, then made his way back to earth.

It was a long time before Norm got over the barley dust of the Clyde elevator and if anyone ever mentioned it, he’d mutter away about how he was “framed”, and that he’d get even some day. I forget how the radio signals worked out from that location, but no doubt they were OK.

In the spring of 1949, we had real cause to try out some of our ideas. An oil well at Leduc called Atlantic Number 3 caught fire. It was located in the field close to the open-wire telephone lines, and there were thoughts that the telephone line might be endangered. It was decided to put in an emergency radio between Edmonton and Devon.

The oil well fire was most spectacular. Even-



Oilwell fire near Devon (Atlantic #3). (1949)

tually, it was brought under control by drilling an intersecting hole at an angle hundreds of feet below the ground surface. I liken this to a feat which could only be accomplished by someone expert in billiards: a four cushion bank to the side pocket with one eye shut, using one of Gibbard’s crooked snooker cues. This relief hole choked off the gas and the fire sputtered out.



Emergency radio system — Edmonton, Devon: Art Davis standing beside antenna mounted on Provincial Building. (1949)

The highlight of the job was mounting the antenna at the Edmonton end, on top of the downtown Provincial Building. Art and I installed it, and the radio was US Army War

Surplus equipment supplied by Fisher Brothers. We put a small 3-channel carrier system on it as well. I was scared stiff as I edged around the narrow ledge of the elevator house on top of the building to secure the guy wires. The building was several stories high and the ledge offered just a toe hold. I now much respect a mountain goat that has to live in such an environment.

Radio in those days was unpredictable, and much had to be done to bring it up to telephone standards of transmission. I remember while doing the 150 mHz survey that I picked up a Seattle radio station on the same channel. This was a freak reception, as normally a 150 mHz signal is only good for line-of-sight contacts. It was, however, at the time of peak sun spot activity (1948-49), when world-wide radio signal reception was fantastic. Sun spot activity, incidentally, peaks on an eleven-year cycle, and is almost as predictable as the weather. Freak radio reception has to do with signals reflected from the ionosphere high above the earth, and not ground wave signals. Even though ground wave signals are not normally reflected, they were in this case, due to the density of ionization in the heavens.

Of all the work relating to radio communication, the design considerations and problems associated with the radio path and antenna systems are the most interesting to me. This field of radio engineering is certainly one that gobbles up money. Many radio routes have to be tested in the wilds of the north, through muskeg, or on the peak of some craggy mountain in the south. There is never anything hard-and-fast: radio paths alter because of the growth of foliage, the water table changes, or tall buildings spring up near the path. Mind you, this mainly affects microwave frequencies. I do remember, though, that a case of mobile (150 mHz) interference once cropped up at Brooks. Apparently all of a sudden a road was built near a mobile radio base station, and the ignition systems of passing cars and trucks created severe interference. Several methods were tried to stop it, such as using screens and shields made of chicken wire. These didn't help, and the station was eventually moved to a more favourable location.

The mobile radio network has seen great strides of advancement since that exploratory beginning. Networks now allow coverage from border to border, tying in a mobile telephone service that has transmission quality only marginally behind that provided by high-quality land-line equipment. A feature has recently been

added which allows car to car calling. This apparatus is entirely solid state, operating on 800 mHz, and weighs no more than a couple of pounds.

Yes, mobile and point-to-point radio have come of age, filling a gap that links the distant construction worker with his city, office or home. While this operation is in the 150 mHz band, the higher frequencies are now being invaded, and now 450 and even 900 mHz see similar uses. These upper frequencies are mainly employed for fixed locations where one Yagi antenna eye-balls another some 40 miles away.

Just after the 900 mHz radio band was opened up for use, concern was raised over the fact that this communication band might be subject to interference by the microwave ovens which were becoming so popular in homes. Because the frequency of these high powered microwaves was close to the communication band, and with the signal being splashed around inside the oven, there was a possibility that stray R.F. would leak out and radiate into communication equipment. This brought about the purchase of several pieces of test equipment expressly for measuring the amount of R.F. leaks. However, everything worked out, and housewives got along really well with telephone engineers.

Other radio applications have sprung into use, such as paging systems. These allow a person wearing a small receiver to be contacted as he goes about his work. He will hear a short beep or a voice message. Recently, a type of tone signalling has come into use that permits up to 1,000 discrete units to be signalled. Several transmitters operating in parallel provide complete city coverage.

These are just a few of my experiences with radio. In the old days, Art and I crudely carried out our path investigations to determine the coverage in the Athabasca and Caroline areas. Now, that rough and ready method has been far out-done by modern equipment and operations — radio is a technology that has caught fire, whipped by a wind of industrial growth.

“Carrier” — The Workhorse of the Network

MY EXPERIENCE with telephone carriers really started when Russ assigned me to the Calgary Wire Chief's Office in 1949. He decided that I should get first-hand knowledge of test-board procedures and equipment in a toll office, so accordingly, I spent most of one summer in Calgary toll office.

Gerry Byrne was the Wire Chief at the time. I remember him well, as he instilled the fear of a blast furnace in me if I ever blew a thermo-couple in one of his transmission measuring sets. It was an unpardonable sin in his mind to do so. It was also good for 15 minutes of colorful adjective-spiced lecture, referring to the victim's knowledge, ability, character and stupidity ... I know!

Incidentally, Art Davis is the only person I have run across with reflexes fast enough to take his finger off the release button on a 30A transmission measuring set before the meter needle hit the top of the scale on overload. This prevents popping the thermo-couple or making

the needle look like a frizzled pretzel. I found that when this happened with Art, it wasn't even wise to snicker.

Perhaps I should explain what a thermo-couple is. It's a small wire-like device enclosed in a glass bulb, used to make accurate power measurements of minute high frequency AC signals. An AC voltage is impressed across a short length of resistance wire that is about as big in diameter as a curly hair on the proverbial blonde. This in turn heats the junction of two filaments of different metal that are welded together, and this causes a DC voltage to be generated. The amount of this voltage is in proportion to the AC signal that was applied to heat the junction. This device allows AC measurements by a standard DC microammeter.

The thermo-couple came into use with some of the earliest telephone instruments. There were, for example, a 7A Transmission Measuring Set and a 2A thermo-milliammeter for VF and C carrier use, plus a 30A Transmission Measuring Set for 1000 Hz VF testing.

The thermo-couple sees use even today in the most sophisticated measurement of radio frequency power using bolometers and other high frequency measuring devices. About the only difference between the older sets and the new is that the whole instrument is now about 6 inches square and weighs no more than 2 pounds, compared to the 7A and 2A of old that we used to lug around. They were the size of a suitcase. We still lose the odd thermo-couple through misuse or a trigger finger that's too slow in getting off the 'protection button'.

Jerry started me out with Freddie Whiffin, who was looking after DC telegraph, then with Jack Mulligan, who operated the 18B primary test board and did carrier maintenance as well. Both fellows were thoroughly competent at their jobs and taught me a great deal about telephone equipment and toll office routines.

I was fascinated with Wheatstone Bridge measurements carried out on the 18B test board for trouble-shooting on the open wire lines. These were either opens, shorts, crosses or grounds. I was also keenly interested in the 4-cycle AC method of using the bridge for finding opens on the lines. I used this type of Bridge a great deal later, but cut my teeth on it in this office. I obtained a good basic understanding of its principles and uses for such things as Varley and Murray Measurements, as well.

Jack used to have me check out the 'C' carriers (I think there were only two systems in the

office at the time). I particularly remember one system, an old black one that occupied two 9 foot bays — just think — all for three voice channels. Today we have hundreds of channels in a fraction of the space. But when this old 'C' was laid to rest some 25 years later, its vacuum tubes tested as good as new. The tubes were as big as light bulbs and perked away year after year, never getting riled up or excited about anything.

One thing imprinted in my memory about working around toll offices was the clanking of the sensitrol relays on the 'C's' and 'J' carriers. They would clank away in spells at 5 second intervals, changing the gain of the amplifiers as needed. They were in turn under control of the Adlake timing devices. A small telechron motor responded to the contacts of the sensitrols, which rotated a variable capacitor that had several segments in its stator. This acted as a capacitive voltage divider in the input of the line amplifier. It was a reliable electro-mechanical system for automatic level control, and did the job very well. Of course, the secret behind the whole thing was a pilot signal, the level of which was sensed and used to actuate the sensitrols.

This system showed up later in the 'J' carrier, with the only difference being that the wider frequency range needed more control (i.e. 5-35 kHz vs 36-143 kHz). More than one pilot was needed because the slope of the open-wire attenuation changed a great deal with weather and had to be compensated for. This necessitated what was called "slope regulation". The other pilot provided flat regulation.

The old 'C' was quite a carrier (on the first typing of this manuscript, the word carrier came out 'character', I think I should just leave it that way as it aptly describes the old work horse). As mentioned, line frequencies were 5 to 35 kHz, which were so high that they often could be knocked out entirely by frost. However, in one or two cases, a system was even found working faithfully with its open-wire lead smothered in a snow bank.

Another Toll Office sound that holds vivid memory is the whine of a milliwatt supply. This was small alternator driven by a 110 VAC synchronous motor, usually mounted at the top of the 18B test board. It was arranged to start when a 'patch cord' was placed in its output jack. It was really quite an educated little machine as its frequency was dead accurate (1000 Hz) because of the constant speed of the synchronous motor that was locked to the mains frequency.

Its output was clamped at a 1 milliwatt level, held constant by thermistors that compensated for rise or fall in output. It would whine away by the hour as V.F. tests were made, wailing the weirdest sound whenever it was started or stopped. It reminded me of a coyote that had sat on a cactus (and dang'd if I haven't heard lots of them that had possibly done just that). We don't use these little machines anymore — possibly the transistor became jealous and relegated it to the back room. Well, I suppose change is necessary.

Some of the other carriers that I worked on at the time were the 'H' and the 'G'. The 'H's' were frequently used to derive one more talking channel over and above the open-wire circuit. The 'G' was unique, in that it had one 'passive terminal'; its 10.3 kHz carrier was modulated by voice frequency signals to create the two sidebands. The carrier was sent singing along separately to the far end where it was used to demodulate the signal. The carrier was then phase shifted and re-modulated there by another voice signal. It was in turn sent back to the active terminal where it was demodulated for the second ear to hear. This carrier system was rather complicated, somewhat crude, and required much engineering, but it did bring in extra pesos by making another circuit available. I trouble-shot the old 'G' between Leduc and Thorsby for a couple of years. There was another 'G' system between Granum and Fort McLeod. I think it was much less cantankerous and didn't need as much caressing.

In 1949, Art, Lee, Frank Watkins and I installed and aligned a 1 + 4 carrier between Lethbridge and Cardston. This was an English Army carrier which arrived so well packed, crated and sealed that the sandstorms of the Sahara wouldn't have penetrated it for 10 years. I think it could have been dropped from 1000 feet without shedding a splinter; it had about 10 pounds of screw nails holding each side of the crate on and must have had the wax of 40 colonies of bees sealing it.

Lee and Art took off for Pincher Creek, leaving me at Lethbridge. It was then that Frank came to my rescue — he'd detected my dilemma as he spotted me feverishly leafing from page to page in the instruction book. But he was prepared — he was always prepared, mainly because he already had spent several sleepless nights pondering over prints and manuals for the equipment. He was always one step ahead of everyone, so when he saw me flounder-

ing, he came over and put his hand on my shoulder.

"How's it going, Bob?" he said, "Anything I can help you with?"

God! What welcome words. There I was, trying to impress Davis, or even for that matter just tryin' not to act too dumb.

"It's all Greek to me", I said. "Frank ... I was just tryin' to figure out this manual so I could make some initial adjustments ... I think those 'limeys' have written it the same way they drive a car down the road ..."

Without letting me finish, Frank had the page open to carrier levels. He sorted out and adjusted each one using the built-in meter at the top of the bay. We were now well on the way.

Just as we'd finished running the connections to the rack and had made the last tweak, the phone rang.

Art hollered, "How you doin', Bob?"

I replied, "Real good, ready to go!"

I could tell he was surprised. He said, "Sure you did everything? There's a lot to it ..."

Art was quite taken aback when I replied, "Yeah! Ready to go!" I never did tell him that I had an expert guiding me.

Frank was always assisting me on one job or the other when I was in Lethbridge — he was a wonderful person who got a particular thrill out of helping the less experienced guy. A man to whom I owe much, and have great esteem for. I'll swear he knew every pole and insulator by name in his district. Whenever he helped, he made you feel like you'd thought the idea up yourself; he took no credit at all.

Another time in 1950, Lee and I went to Lethbridge to do the acceptance on a newly installed 'C' carrier, a link of the Trans-Canada Network. Once more it was learn-as-you-go as far as we were concerned, but we made out real well. We certainly scanned a lot of 'T' drawings,



The author at the test board in Ft. McLeod. (1950)

*"Carrier" —
The Workhorse
of the Network*

though, before we got things perking. Later this became the name of the game: crawling around the floor on acres of prints, tracing wiring, etc. Even today you can identify any old time equipment acceptance guy — he'll have knobby knees from spending so much time down on the floor crawling around on blueprints of one kind or the other.

The 'C' carrier in its day was looked on as a real break-through in getting more circuits over and above the open wire pair. However, along about 1952 the 'J' carrier came into being at AGT. It operated in a frequency range that went way up to 140 kHz (in those days that was really something). Several decisions had to be made regarding its use: for instance, choice of open wire pairs and distance between repeater situations.

Open wire attenuation was a main consideration, especially in periods of winter frost conditions, so it was necessary to determine Alberta's weather picture. Crosstalk measurements, too, had to be made between the various open-wire pairs to find the combinations that had the least coupling. As well, toll entrance cable required capacity balancing to reduce crosstalk between its pairs.

One afternoon Art handed me a roughed-out schematic of a 6-tube receiver, a 140 kHz signal generator and a calibrating unit that he had designed.

He said, "I want you to build three sets of this equipment; I want to measure the attenuation due to frost at 'J' carrier frequencies. I think if you get some 175 kHz car radio IF transformers that they'll tune down to 140 kHz. If so we'll build the receiver around them."

I scouted around town and came up with a couple to try. Sure enough, they could be moved down in frequency. I picked up nine of these, enough to make the rest of the sets. About that time, Roy Usher had been transferred to AGT from radio station CKUA, and he was given the job of helping me build the equipment. On its completion, I installed it between Calgary and Edmonton, Calgary and Lethbridge, and Calgary and Medicine Hat. I instructed the Plant people at each office on how to look after it, then made a trip each month to make sure everything was working properly.

Just about the only problem that cropped up happened in the 'Hat' office, and it resulted in a frantic search around the neighborhood for the test results. Harry Allen, the Wire Chief, had a mouthful of unsavory words for the guy who

left the window open. I spent an hour or so after that trying to sort out a jumble of hieroglyphics because the wet snow made the ink run. The inky mess looked like an ancient mosaic depicting a herd of giraffes cavorting in a patch of tall sugar cane.

The results of the frost attenuation measurements did much to determine the location of the brick, 'J' repeater stations.

The next job to come along was crosstalk, which fell into Gib's lap. He was to guide most of the 'J' crosstalk testing from then on for pair selection, and so on.

Open wire crosstalk seemed to be a never ending job. Art originally obtained a small 'tear drop' style trailer to house the equipment at one end, and our new Dodge station wagon (#51) was to be used at the other end some 40 miles away. The wagon was equipped with filters and test equipment racks much the same as the trailer. The idea was to connect a line filter into the open wire pair at each end, which would allow the 'J' test signals to be isolated from the working low frequency ones carrying traffic. This was done on two pairs at a time, so tests could be carried out between them.

Insertion-loss and crosstalk measurements were made every 10 kHz in the 'J' range. The test leads from the equipment to the top of the pole were unique, as they had to match the impedance of the open wire and be of very low attenuation. They were also made in a way that would reduce movement of the leads. They were constructed as follows: 1 pair of style B (drop wire) was used for each side of the test lead. Its tip and ring were twisted together to form one wire, and wooden slats approximately 8 inches long were secured between the two runs of wire making a ladder-like configuration. This resulted in a connecting lead of approximately 600 ohms impedance. This is close to that of .104 copper 8-inch spaced open wire, so a fairly good impedance match could be obtained between it and the line filter in the trailer or car. A jack-strap was used to hold the wire while it was cut. The test leads were next connected in each direction. By doing this, VF signals would be routed through each filter.

The Wire Chief was always contacted prior to the actual cut, a count down was started, then a prayer was said. If the cut didn't work, words from the test board, not fitting to the prayer, surged forth, something to the effect of, "make the bl--- thing normal." We got to hear these words many times before the summer was

finished, in several languages and tones, from other areas and from several other Wire Chiefs. They always had the same warning. These tests went on for about 3 1/2 years — we got to know every ‘S’ pole (end of an open-wire transposition scheme) and transposition by name before we’d finished. The language used by Wire Chiefs added much bluish hue to the dull colour of telephone terminology. It put the Chiefs in a class with such idolized individuals as bull drivers of old and Sergeants Major of the Bengal Lancers.

Our test equipment consisted of a couple of Hewlett Packard oscillators and Western Electric 31B transmission measuring sets. These instruments were tunable and had a 140 hertz band width. The insertion loss of each open wire pair to be tested was also measured, as it was necessary to apply it as a correction factor to the Far End crosstalk reading. All of this resulted in about 40 measurements per combination for



“Gib” Gibbard climbing pole in High River “J” Station. (1957)

each pair of open wire. This doesn’t sound like much but just multiply by the number of combinations, and consider the tedious tuning of the 31B’s ... resulting in a big job. At first, each measurement took a lot of careful tuning; however, after a summer of this, we could do

it in a flash. We developed fingertip sensitivity that would make any respectable safe cracker envious.

After the two pairs were measured we’d restore one pair by using micro-press sleeves, remove the jack straps, then cut in a different pair. Crosstalk tests were repeated on all combinations of open wire that could be assigned to ‘J’ carrier (later the Lenkurt 45A carrier operated in the same frequency plan, so was equivalent to the ‘J’). The pole pair was not used; however, all other 8-inch spaced pairs were considered. Crosstalk testing became very monotonous. It took us out Monday morning and back Friday for a good part of a couple of summers. After the results were checked, we found that many transpositions needed changing. The tests were then repeated.

We had various linemen helping us, but the two fellows I remember best are Ronnie Douglas and Dale Hughes. These fellows were as agile as Siamese cats up the poles, afraid of nothing ... There was just one small point though — their work would only last about 15 minutes of every hour. Between the connecting times they had nothing to do, and their favorite pastime became putting an air mattress across the top cross arm some 30 feet in the air, then flopping down on it to catch a few winks. Sometimes we’d have to shake the pole out of its roots to bring them out of hibernation for another wire change.

Often they’d take the quick way down by grabbing hold of a guy-wire, and swoop down at a sizzling clip. The testing finally ended after we’d travelled many thousands of miles and completely wore out the dial mechanisms of the old 31B’s. Their knobs became round and polished from use.

It was an attempt to measure open wire crosstalk in the ‘J’ frequency range on the Medicine Hat to Tilley section. In the early spring, of 1951, Art and I started out to do the job. I rented a truck and an old trailer, and off I went with all our goods and chattels heading for Medicine Hat, Art following in the car. The weather was frosty, the roads as slick as greased electricity. The wind screeched a banshee tune through the wires as I drove along. They later told me that this was standard weather down there. Surely the local people have one leg shorter than the other from walking at an angle against the wind. Anyway, it was quite a trip.

I’d never pulled a trailer before, and this was a big, heavy, unwieldy thing, with no hitch stabilizer. Several times the trailer and truck sail-

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planed suddenly across the icy road. Hanging on desperately, I finally straightened them out. It did indeed liven up driving on the arrow-straight, monotonous road.

Art was waiting when I arrived. We spotted the trailer at the terminal pole, then unloaded the test gear. Art started setting the equipment up.

"How about connecting the power . . . I could use a light in here," he hollered.

The electricity was to be obtained from an outlet about 150 feet away, using a heavy cab-tire power cable I'd made up in Calgary. I'd connected a dual outlet to one end, and a heavy duty attachment cap to the other. I checked for voltage at the pole, and it was OK. Just for kicks I checked at the end of the cable — Gosh, there wasn't a flicker. Now how in heck could a journeyman electrician go wrong in making up a simple power extension? Good gosh! I'd even used the approved underwriters' knot!

I could see right then that my stock had dropped out of sight in Art's eyes, as he wasn't very happy about not having power in the trailer. He grumbled away! Hearing the tone of his voice, I kept well back, trying to figure how I could have made such a mistake. Once more I tested things with the voltmeter. Sure enough, there was juice at the pole, but not a bit at the end of the cable. I yanked the plug out of the outlet, put a short on the cable and tested it with the ohmmeter.

"For crying out loud!" I yelled, "The darn thing's wide open, there's no continuity in the wire. . . how in heck are we gonna find an 'open'? We'll end up with a whole armful of short lengths of cable if we start cutting it up."

Art pondered the situation. "Keep the ohmmeter connected and I'll move the cable around and see if you get a reading," he said.

Walking back and forth shaking the cable brought not a flicker. There wasn't a place that gave any indication of trouble. Suddenly he stopped.

"Bob, get some wire . . . maybe some rack-wire . . . wind about fifty turns around a tin can, we'll make a 'pick-up loop'. We'll put a high frequency signal on the cable with the oscillator, then use the pick up coil connected to the 31B. We'll see if we can detect the signal along the cable. Maybe we'll get some indication at the break."

I went to the toll office and talked Harry Allen out of about 50 feet of rackwire, then found an

empty Esso can at a service station. I wound the turns on as I walked along. By the time I got back, I had all of the wire on the can. I then slipped black tape under the coil and wrapped it tight, then pulled it off and secured all of the turns. This ended up as quite a professional looking loop.

We connected everything, then searched along the cable for some sign of trouble. Sure enough, at about the middle the feeble signal petered out. We switched ends, and once more the test showed something funny at the same spot.

Art said, "Gimme your cutters!"

He cut through the cab-tire cable about 4 feet on each side of the spot where the signal changed; stripped the rubber off, then the jute surrounding the pairs, ripped it back . . . we both let out a yell.

"What goes on! Look at the rope in there!"

Apparently a piece of twine had been formed into the cable in place of one of the wires. Now rope doesn't rank very high on the conductivity list for electricity . . . we'd found the trouble.

Art let out a couple of cusses, "Those dumb so-and-sos..." as he walked away.

How this came about at the factory I'll never know. I remember, though, that Art kept the sample around the office for a long time. It was well identified by the manufacturer's name proudly stamped on the outer casing. This brought an immediate end to any future claims of quality cable by that company.

As for myself ... well, I was relieved and felt that Art would surely understand that I could make up a simple extension. He never said much, though, and I often wondered what he thought about the situation. We'd lost some time over it, but I think he felt pretty good about applying some old ingenuity to find the trouble.

Actually our problems were not over. After we got the Medicine Hat end fixed up, Art headed for Tilley. The building at Tilley was about half completed, so the furnace was not yet fired up. The building had a sheet-metal roof that had become coated on the inside with at least 4 inches of frost. Art set up his equipment, lit up a couple of heaters and went into town for lunch. Sometime later I called him on the telephone and heard what sounded like a broken SOS in Hindu. He excitedly related about coming back to a flood. The heaters had warmed the inside of the closed building and water poured down from the roof. It was dripping

down on to the test equipment and all over the place. When I arrived, Art was still drying out equipment and mopping up water. We finally got things straightened around, dried up, powered up and started our 'J' open wire crosstalk test from Tilley to Medicine Hat.

Vaughan Monson and I went back a year later to retest this same section. Bill Smithson was the new Wire Chief in the 'Hat', as Harry Allen had been transferred to Edmonton. We explained to Bill how we would cut the low pass filters in, and tried to prove to him that this wouldn't cause the slightest flicker of his alarms. Well, Bill being a Wire Chief of old was not to be hoodwinked by a couple of young guys. So he grabbed his 'trusty ohmmeter' and up the pole he scrambled: he tested, checked, eyeballed and monitored every move we made, and he did this for every cut! He never let us out of his sight while we were near his terminal pole. Wire Chiefs ruled their toll leads in those days like kings ruled feudal systems in the days of the Crusades.

Once, when testing the Tilley section, we were informed that there was line trouble and that we would have to wait until the 'carriers' were restored before we continued our tests. We waited all morning but the trouble still prevailed. Finally, I decided that if we got going, we could cut directly into the open wire instead of the time consuming procedure of cutting in line filters.

"What the heck! The line's dead anyway. We can surely get our testing done before it's turned up again," I thought.

Halfway through the measurements, the telephone rang and the test board wanted to know if we had done anything to prevent them being able to turn up one of the 'C' systems between the Hat and Calgary.

I went to some length to explain that I was trying to save time and money . . . (I had a whole string of other excuses as well) and had cut the open wire line for testing.

Well! We got full credit for this outage. The news travelled to Art and Russ faster than an ion-propelled flying saucer. I was to appear in Gerry Byrne's office the next morning 'sharp' at eight. This I did, and as usual, Gerry did all the talking — I did all the listening. It was the last time I pulled that kind of a stunt.

The only other time that I had a knee-knocking opportunity to stand in front of Jerry was when my finger slipped off the 'protection key' of his 7A transmission measuring set. The needle made a sudden rush to the top of the scale

then fell back limp and lifeless. The thermocouple was shot.

By the time we were finished, the 'J' carriers had practically become a part of us. For instance, we were really concerned whenever hoar frost was on the wires because it caused considerable attenuation to the signal. The 'Cheadle Cluny' coulee was the worst section of the whole lead for this. We always seemed to be checking transposition schemes as well, or looking for broken insulators, shorted wires and other line troubles. The 'J's' indeed had become tradition. Even after they were installed and working we spent many nights measuring crosstalk between channels. There were 12 channels which made many combinations, and this caused a lot of yawns and bleary eyes the next day when we took readings throughout the night.

Our AC power for the field tests were supplied by portable Onan power plants. They were the most cantankerous, unpredictable, uncooperative creations that ever turned out a watt. I remember pulling on the starting rope by the hour trying to get one of the ornery machines to show a spark of interest. This provoked me to much profanity; I do know that a sound kick with the toe of my hobnails often brought them to attention. Something like the guy with the mule that wasn't too interested in responding to commands ... first he had to hit it between the eyes with a '2-by-spruce' just to get its attention; then it sat up and really took notice.

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Bob Moore starting portable power unit for J-Carrier testing. (1951)

When we cut in the 'J' repeater station at Didsbury, Gib and I went through the equipment with a fine toothed comb ... everything seemed to be in good shape, including balancing the 'spiral 4'. Jack McCuaig and Kenny Kinnon were the linemen helping us. It was as cold as Baffin Island. Heavy frost had the wires weighted in a skipping-rope fashioned catenary. The line crew could work outside for only a short time then would have to come in to warm up. No one was in a very gentle mood. I think Jack sensed this and decided that a chuckle was in order. The next time he came in for a cup of coffee, with his unique brand of humor, he related the following yarn.

He said, and I quote: "You know ... if yuh ever go into the woods and you're afraid a' gettin' lost ... just take along a deck of cards ... then if you lose your way, just sit down on an old tree stump, clear the ground in front of you and start playing solitaire ... it'll be no time at all before someone'll tap you on the shoulder an' tell ya to put the 10 of Diamonds 'neath that black Jack that's showin'."

Not the best joke in the world, but pretty good for 3:00 a.m. on a wintry night when you're blue with cold, miserable and don't give a tinker's dam about telephone equipment. I have always enjoyed working with Jack, having done so many times since then. However, I have never forgotten that first time, the night of the Didsbury 'J' repeater cut.

After finishing the frost attenuation measurements, we ended up with a lot of equipment that was not much good for anything else. One day Art got a bright idea.

"You know, Bob," he said, "there's a frequency slot between the top of the 'C' carriers (36 Kc) and the bottom of the 'J' (40 Kc), and they both occupy the same open wire pair. It's therefore available for an intercom — it's free spectrum!"

He continued, "How about converting one of the frost measuring units into a 'Carrier' style intercom for our use between here and Russ's office in Edmonton?"

It didn't take me long to modify it and get it tuned to operate on the frequency he'd mentioned. I arranged it to be 'push' to talk, using a carbon button mike and a small speaker so it could be heard at a distance. I installed one unit in Russ's office and the other in Art's. This worked the very first time and served as our own private talking circuit between Calgary and Edmonton for a number of years. It was

christened the 'Squawk Box'. I didn't think this fitting for such a noble little carrier that worked 200 miles without even a repeater. Our signalling method was simple, cheap and effective — just a good loud whistle or a holler into the microphone.

The 'J' carriers were built solid, massive, reliable and costly. Not many problems ever cropped up, but I do recall one that had to do with the crystal filters. One of the main reasons the 'J' gave such good performance is due to the excellent filters it employed. These were built around quartz-crystal-resonators: a filter built of quartz crystals instead of LC circuits has an excellent shape factor and, in this case, resulted in extremely good control of the channel and group frequencies. This reduced crosstalk and intermodulation noise to a minimum. Quartz crystal demonstrates what is called 'the piezo electric effect'; it behaves like a very sharply tuned series resonant electrical circuit. Brazilian quartz (and this is where it came from originally) is, however, expensive. Nowadays crystal of this type is made by a chemical-growing process, so most filters now employ this material, as did the 'J' carrier. There is just one trouble with artificially grown quartz crystal, and that is the quartz does not always stop growing. Even after it is cut for electrical use, it often produces thin hair-like extensions called 'whiskers'. This is exactly what happened in a few cases with the crystal filters employed by the 'J' carrier. The little whiskers often reached out and touched other neighboring whiskers, thus shorting out the circuit.

It was found that one way of removing these whiskers was to apply a small amount of DC voltage across the crystals. It was necessary to take precautions not to apply too much, otherwise the crystal would fracture. One day Art asked me to unsolder the case of a defective unit, so he could examine the crystals with a small microscope. He wanted to see if our crystal filters had this migrating desire.

"Well, what do you know!" he muttered, "Look at these little fine hairs, bet they're whiskers."

We applied a small amount of DC ... and that was the end of the 4 o'clock shadow on the little quartz resonators. After that it was quite easy to clear a filter that had a whisker or two ... just burn 'em off.

By the time the 'J' carriers were installed, numerous people had taken part in its acceptance and line up. Gib was now in charge of the

Calgary office, Art had left the Company and was now with Calgary Power, Lee Harrison had gone to Edmonton, Doug Lawrie, Bob Taylor, Vaughan Monson, Bob Meikle, Steve Nicol and myself were in the Calgary office. Bill Powell came down from Edmonton and assisted a few times. Bill accompanied Gib and Bob on these trips, and they used to relate some vivid tales of how white Bill's knuckles got from hanging on as they blazed back and forth from one repeater site to the other in the Chev car. It became quite a contest between them to see who could get Bill to hang on the tightest. The roads were gravel and mud in those days. Gib used to claim that old #68 never did steer very good, until, on one of the trips, he came to a washed out culvert unexpectedly and had to jump it ... he said that after that it steered like a 'hot darn'. It's his story.



"Gib" Gibbard testing J carrier: Calgary to Red Deer. (1955)

I think Gib figured he was still flying a 'Beaufighter', as he'd served two Operations in the Air Force piloting one of the big black twin engined fighters up and down the herring-infested waters of the Norwegian coast. Gib would roar down the road. Many times when Bob was in the car, if a pigeon happened to be on the road, Gib would head for it just to get

a retaliating remark from Taylor.

Bob kept racing pigeons and had a deep spot in his heart for them. One time Bob came in with gloom oozing out from head to foot. It was reported that several of his missing birds had ended up in a restaurant stew pot ... Bob could not pay attention to his work for days after that.

On one trip, Gib and I started out for Red Deer. The roads were glare ice; the ditches were deep with snow. We were making out very well, when suddenly we went into a spin. Around and around we went, getting closer to the ditch with each revolution.

Hang onto your hat! he yelled, and in we went, snow flying in every direction.

Finally we found we were completely buried inside a big snow bank. What a scary sensation! All was quiet. We couldn't open the doors; we could hardly see each other. We were trapped for some time before we were able to burrow out. Eventually a lumber truck came along and hauled the car out of the ditch. We were none the worse for the experience and continued on.

That same day we came across many others who shared the thrill spinning like a top on the glassy road. It was comical, as often a car would pass, and Gib would turn and say, "bet ya 5 he won't make it a mile!" Sure enough, around and around he'd go, then into the ditch in a big gusher of snow.

I have one last thing to deal with pertaining to 'J' carriers: cable balancing at the higher frequencies used by the system. Because the open wire toll lead stops at the outskirts of a city, the 'J' circuits had to be extended to the toll office by cable. This was called the toll entrance cable. The frequencies for 'J' carrier were 40 to 140 kHz, so could not be carried by the C- loaded pairs that had a frequency cut off of about 36 kHz. Because of this, the 'J' signals had to be brought in on non-loaded cable pairs. However, the wire-to-wire capacity balance was not quite good enough, and excessive coupling often caused crosstalk from one pair to another. Achieving better balancing involved the use of large cast-iron boxes with cable terminals inside, which allowed termination of each wire. It also allowed a special capacitor to be mounted near any 'wire to wire' combination that needed balancing. These capacitors were made of two parallel insulated wires wound in bifilar fashion on a porcelain form. The porcelain form was threaded, thus allowing it to mount on a bolt between the two wires. The capacity was adjusted by clipping some of the wire off.

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Crosstalk measurements were again taken, then capacitors placed between the next worst wires. These two were adjusted until the crosstalk was brought within requirements. The next worst combination was then adjusted, then the next, and the next, until all pairs met requirements. This was fine and dandy, except that you likely found that you had connecting capacitors that were actually cancelled capacity that you'd just put on.



Ft. McLeod J station: Doug Stewart, Bruce McKenzie, Walter Inglis. (1956)

Anyway, this was the general procedure used to balance the non-loaded 'J' cable pairs to reduce the crosstalk within the cable. A coupling loss of about 80 dB was obtained by this method. The balancing panels were located either at the terminal pole or at the office end, in the cable vault. Steve Nykiforak (Nicol) and I carried out many months of 'J' carrier cable balancing of the various toll entrance cables in the Province.

One particular day I was travelling by car from Edmonton to Calgary. Approaching Wetaskiwin, I was forced to slow down as many cars were stopped. Apparently a truck had left the road and run into one of the telephone poles. The pole snapped off at ground level and the force of the impact swung the pole up and over and around several times. The toll lead that usually consisted of about six cross-arms of wire was now neatly wound together like a wire rope.

If I hadn't appreciated the seriousness of the situation I'd have found things quite amusing. Just to start untangling that mess of wires was something to behold. I stopped and offered my assistance but found that Mr. Roy Greene Sr. had the situation well in hand. Telephone service was restored in short order by using many lengths of 'style B' wire that were laid in the ditch.

Let me veer away from carriers for a moment

to mention a few of my involvements with V.F. repeaters. V.F. means Voice Frequency, a term that goes back to early days of the telephone trade, and used when referring to signals that fell within hearing range. Now it must be appreciated that a voice message, having been transformed into an electrical signal for transmission along a telephone line, eventually gets that 'end of the day' feeling. It suffers a drop in amplitude due to the electrical losses of the telephone line, so it is necessary to amplify it to make it reusable. Once more, telephone people came up with a rather original and descriptive name for equipment for this purpose. They called it a repeater. This device restores (or repeats) the signal to its healthy original state, then sends the 'solid little citizen' on its way to actuate some distant telephone set. However — there happens to be one small hitch — telephone lines carry signals in both directions, so amplifiers are necessarily facing each direction of transmission. The stickler is that, if the output of one amplifier is allowed to feed into the input of the other and vice versa, as would be the case of two amplifiers connected in a line for 2-way amplification, all that would be heard would be one glorious howl, caused by oscillation and, as the telephone man puts it, 'it would be singing like heck'.

The early telephone engineers were not to be stopped by a problem like this, so they came up with what they called a hybrid transformer. This is a device that under conditions of electrical balance routes signals properly through the respective amplifiers, preventing the signals from one amplifier being coupled into the input of the other, thus avoiding the troublesome oscillating condition. When a connection of this nature is used, nice stable amplification in each direction is achieved.

Actually, amplifiers in a howling or singing condition, in all reality, constitute an audio frequency oscillator. The old timers aptly described the situation by referring to it as a singing repeater, and so sprang up a host of tests that measured the degree of singing, or stability. These tests were the basis of the familiar 22 Singing Point test of days gone by. There were several ways of doing this and it was a test that I became most familiar with. I really cut my teeth on Singing Point measurement on the old 22-type repeaters in the Lethbridge office, and it was once more Frank Watkins who came to my assistance. He coached me thoroughly on this test. It served me well in giving me an

understanding of singing point, echo return loss (a related term) and other conditions of balance where a hybrid or four wire set was used. As I was heavily involved in 'terminal' and 'office' balance, and related hybrid balance adjustments, for control of echo at all toll centers in the province, the basic work of learning the old 22 singing point test stood well in carrying out these adjustments.

The large voice frequency repeaters have now been replaced by miniature types (transistorized) and some of them operate on quite different principles, eg. the negative impedance types. These are very handy as they introduce gain into the circuit and yet allow DC pulsing to go through the circuit. This allows dialing and signal amplification of the talking signal at the same time.

As already mentioned, one important requirement must always exist in a properly operating repeater. It must have good hybrid balance, so the amplifiers can operate with stable and undistorted gain. When the line side of a hybrid faces a switchboard, then a simple network such as a 600 ohm resistor connected in series with a 2 microfarad capacitor achieves satisfactory hybrid balance. On the other hand, a hybrid connected to a cable or open wire must use a precision network to bring about balance. This is nothing more than a combination of components like capacitors, resistors and inductors arranged to resemble the electrical characteristics of the particular facility.

Most of the echo on telephone circuits stems from poorly balanced hybrids in switching offices. Trouble caused by echo is always heard by the talker. In actuality, the echo of his own voice comes back to him a few milli-seconds later, and this can interrupt his chain of thought if the delay is excessive. It can also make words sound as if they are being spoken by someone with his head in a rain barrel.

Mention should be made here of a network of communication that was embarked upon in 1954. This was the AGTL (Alberta Gas Trunk Line — now Nova, an Alberta Corporation). It was a network that would cover the province, tying all communication and many control or monitoring requirements of this lengthy gas trunk line. The nerve center for the operation was in Calgary, where a complicated operating console was built. All lines of communication terminated there. For this system, AGT provided a most reliable network of equipment. It was 4-wire operation, including the telephones

proper that were custom built for the job. The system being 4-wire operation meant the use of many 4-wire resistance hybrids to allow breakout and connection of other circuits along the way. These were complicated and difficult to wire up, but very reliable once accepted and put into service. The switching for the network (and this was something to behold) was carried out by tones that were sent down the V.F. channel. A slot was cut in the spectrum to allow the audio tones to be sent along the facility. These operated a Hammarlund relay that in turn operated a Secode mechanical stepping switch. It was capable of numerous conditions of switch, but did have several problems. These were almost all of the mechanical nature.

Once at Brooks we had a case of trouble caused by a boomy-voiced operator fresh up from the Lone Star State. He would trip the relay almost every time he used the telephone, because of the frequency of his extra deep voice. Gib worked on this problem for some time, based on Art Davis's initial V.F. Spectrum study and its relation to good telephone transmission. From this, Art decided what part of the spectrum could be used for the control tones. Gib finally decided on the use of a blocking filter to be applied to the telephone to prevent the erroneous signal going out.

The whole AGTL system has now blossomed into a complicated network of pipe line use, most reliable and versatile in nature.

At this point, I wish to recap the establishment of our Calgary Field Engineering Office.

Art Davis, Graduate Eng.

Came to AGT in October, 1948. Left AGT December, 1952

Lee Harrison, Graduate Eng.

Came to AGT, 1949. (Deceased 1974). Transferred to Edmonton June, 1950 to work in office with Russ Crawford. Russ transferred to Plant May, 1953. Lee Harrison became Transmission Engineer (took over from Russ). Later he became a director of the Company.

Campbell Gibbard, Graduate Eng. (Gib)

Came to AGT, 1950. Graduate Eng. Took charge of Calgary Field Engineering (Gib) Office June, 1953. A brilliant engineer with an outstanding knowledge of electro-magnetic influences.

Vaughan Monson

Came to AGT June, 1950. Retired on sick pension, 1976.

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Bob Taylor, Graduate Eng.

Came to AGT fall of 1950. Worked in Installation, transferred to Calgary Eng. in the spring of 1951. Transferred to Edmonton, January, 1954. Bob guided most Transmission Design during initial toll centering and VNL operation. Wherever there was a problem, Bob was in the thickest.

Bob Meikle

Came to AGT. Left AGT, 1953, came back a year later. Went into Plant heading Transmission Maintenance in Calgary, 1954. (Deceased 1974)

Steve Nykiforak (later S. Nicol)

Came the spring of 1953. Stayed in Calgary when Field Engineering moved to Edmonton. Left AGT, 1969.

Doug Lawrie, Graduate Eng.

Came to AGT April, 1953. Left AGT December, 1956.

B.O. Barham (Nicknamed Bob), Graduate Eng.

Came to AGT September, 1953. Left AGT June, 1957

Doug Stewart, Graduate Eng.

Came to AGT April, 1954. Left AGT February, 1956.

Peter Baxter, Graduate Eng.

Came to AGT May, 1955. Left AGT July, 1956, went to B.C. Hydro.

Roy Carlson, Graduate Eng.

Came to AGT October, 1955. Left AGT January, 1957

R.J. (Bob) Moore

Supervisor, Acceptance and Quality Control
1960 - 81

Other names of people who worked in the Calgary office are:

John Neal - E.I.T.

Lloyd Shepherd - E.I.T.

Vern Larsen - E.I.T.

Ken Green

Plant, but spent a lot of time in our office, his favorite expression as he came in the door was, "It'll never work".

The Calgary Field Engineering Office (Transmission) moved to Edmonton on April 1th, 1957.

The coming of the 'O' carriers brought another flurry of field activity by our section. We now had to determine the handling capabilities of the open wire leads for frequencies in the 'O' carrier range of 40 to 150 Kc.

This carrier consisted of a full complement of 16 channels in groups of 4. Unlike the 'C' carrier that was dedicated long haul, the 'O', also an 'open wire' carrier, was usually teamed-up with an 'N' carrier on the toll entrance cable (since the 'N' was a cable carrier). On this account, the combination was termed an "ON" carrier. It would be used on many open wire leads in a way that could drop banks of channels off to serve villages and towns along the way, which meant that much open wire had to be checked for crosstalk, attenuation and general transmission.

Our tear-drop trailer was now fitted for 'O' carrier testing. It soon bumped along miles of roads off the beaten track, behind various prime movers.

As a start, in the summer of 1956, Bob Barham and Vaughan Monson tested the open-wire lead from Calgary to Banff, then carried on to do numerous other 'leads'. Bob could often be seen scanning the horizon for war parties while testing the 'lead' through the Morley Indian Reserve. He was not long out from Trafalgar Square and most gullible. Vaughan made the most of it by telling him that he could see smoke signals puffing from the top of some distant hill. This snapped Barham to sprinting pose in nothing flat.

An interesting thing about the 'O' carrier is that the carrier signal itself is transmitted, and therefore available at the far end to demodulate the signal without the need of injection carrier. The banks of channels were in groups of four, with 16 channels in all. This could, however, allow crosstalk to be understandable, so the secrecy of transmission was at stake. As the system was on open wire, it was often subject to crosstalk, and I think a small amount of noise was inserted into the carrier to mask understandable cross talk. This really had two effects. First, it drowned out any low level crosstalk and gave the telephone set a 'live feeling'. People are funny ... they just don't like talking into a telephone set that is perfectly quiet. They like to hear some noise. It gives them the feeling that the instrument is 'alive and willing'.

The 'O' carrier turned out to be a real boon, as it conveniently served small communities with high grade, good transmission telephone circuits.

Switching Equipment— One Step at a Time

THERE are two things prominent in my memory of my association with step switching equipment: the work I did on the A and D relays in the talkbridge of connectors and DC pulse repeaters to improve their electrical balance, and trouble-shooting cable faults that tied in with these switching offices.

Early in 1949, Art Davis decided to investigate the noise on the trunk cables in all the switching offices in Calgary. He was concerned about the electrical balance of relays in the battery bridges, as they were the main cause of poor electrical balance. This created noise on a circuit, because the relays' mid-point was connected to ground. This noise was usually a hum caused by frequencies related to AC power.

My first part of the job was building a test set to allow me to check the relays in the connectors. This work included similar relays in the DC pulse repeaters, as they too had a bridge with their center point grounded through

the battery. I built the test set from well balanced inductors and capacitors, along with various switches and other components. They were arranged to allow the connector assemblies to be conveniently attached. The 1000 hertz loss of each unit was measured first, then the AC balance to ground.

I spent all winter testing this equipment in the Main Exchange in Calgary. In a case of poor balance, various components were changed to bring each unit to a high degree of noise rejection. I found that the "scramble wound" relays nearly always had worse balance than the "sandwich-wound" type. It was the start of many hours days and months of work to improve the transmission of local telephone circuits.

After this work was completed, Art went on a real circuit clean-up campaign in Calgary. He had Bob Meikle, Vaughan and myself all checking battery bridges, bank contacts, battery connections, grounds and you name it in each switching office. This brought us in contact with Mr. Topley ("Top", as he was nicknamed) in the Main, Joe Chamberlain in the West, Bert Reynolds in the South, Ole Gardner at the Hill, Les Ferguson at Louise and Doug Thompson at the East. Each was dedicated to his job and devoted to giving people good telephone service. Training in those days was unheard-of, and each had learned his trade the hard way — the trial and error method! Each man proudly kept a book of records — of how things were hooked together, of how they worked, along with their peculiarities ... all collected over years of experience. Their notes differed but each did the trick.

One morning, I went to the South office, as I had some unfinished work on the connectors. Bert met me in the door, and with gestures unbecoming to his good nature, ordered me off the premises.

"Outta here!" he declared. "I don't want any of you young bucks in this office again."

I thought, "What have I done?" I'd fixed up everything before I left the previous night. But I obeyed his arm waving and took off.

Later that day I returned and he once more met me at the door. However, he'd calmed down to only a light hue of blue. He exclaimed about the dumb so-and-so working for him who had cut all the wires of a cable terminating on a main frame, instead of pulling the heat coils. Apparently an outside cable had gone bad and was causing many of the line switches to chatter a chorus of complaint.

Bert finally pulled all the slack out of the cable stub he could and connected it once more to the frame, bow string tight, making the best of a poor job of cable termination. He muttered away in a somewhat foreign language as he did so. His helper never set foot in the office again.

When Bob, Steve, Vaughan or I went into these offices, we did so under a watchful suspicious eye. We had shiny boxes with fancy dials and flickering meters. These people had never seen them before. They exhibited an "I don't believe you until you show me" attitude, and we frequently heard, "You guys are not gonna wreck my office ... get out!"

We had overlooked one thing: although we had a fairly good idea of how telephone equipment worked and what we wanted to do, we had not generated trust and demonstrated concern for service. Then too, we had not come up the hard way! These people had — and with no help from others. They also did not have the fancy gear and conveniences we had. When a problem cropped up they lived with the equipment day and night until the trouble was found and cleared.

These were very dedicated people with a sense of pride in the trade seldom seen to this extent today. More importantly, down deep, when you got to know them, there was an disposition to friendship that once bonded was never broken.

Yes, the foreman of an Exchange Office was a stern man, dedicated to his occupation, most concerned about service and deep down a "Prince of a guy".

To back up the operation of switching office were miles and miles of cable, a virtual web of communication: trunk cables from each exchange to the other, subscriber loops from the subscriber to the switching office. With this was the never ending case of cable trouble. Sleuthing down the location and cause of a cable trouble was a job we became most involved with.

I remember one case which occurred just in front of the Louise office in the fall of 1949. The trouble was on a cable snaking its way to the Hill Exchange. Art sent me out to find the trouble, first giving me a short course on how to use the Wheatstone Bridge for DC fault locating. That evening I took the books home and studied the operation of the instrument, then worked out several hypothetical problems.

Next morning, I headed out to the Louise office with the confidence of Mohammed Ali. I expected to find the fault and be back by coffee break. I stomped in boldly and demanded

to see Mr. Les Ferguson, the foreman.

When Les came out of his office and saw me, a young shiny faced, slick haired, tie-in-place guy carrying a brief case and an armful of instruments, I don't think he could believe his eyes. There was no way he was going to let me lay a hand on his cable rack, his switching equipment or any part of that switching room. It was beyond all realms of possibility that a greenhorn would come brazenly into his office to try and find a trouble that he'd been working on.

He turned iridescent crimson. I remember his words but wouldn't dare put them in print, but boiled down, they meant "GET THE H--- OUT, and don't ever come back."

This shook me down to my toes, so back to the office I crawled. I related the story to Art, all the while trying to convince him that Les really didn't require my assistance. Art was not only in strong disagreement, I detected a reciprocating iridescence which started at his collar and quickly spread to his forehead. After a couple of short sharp telephone calls, he told me to go back and find out where the trouble was.

I was not keen on this at all, and spent at least ten minutes on the door step of the Louise office before I ventured to try the door. I pried it open a bit to find Les' eye-balls only inches from mine. He was still glaring, but had mellowed a bit. However, I couldn't turn around or take a step without bumping into him. He kept right behind me, muttering away ... I couldn't understand it!

I connected the Wheatstone Bridge to a 'bad pair' and started my testing. The test showed the cable was shorted and grounded. I plugged the readings into the bridge formulas and worked out the distance to the fault. It measured to the street just in front of the office. I then took my equipment to the Hill Office and repeated the measurements, which also showed the trouble to be back at the Louise end. I reluctantly informed Les that the trouble was just outside his office.

This didn't help Les' state of happiness one little bit. I should really say that it brought another surge of rapid dialogue and a torrent of cuss words, and once more he grew scarlet. My initial contact with him was mild, compared to his reaction when I added that the street would have to be dug up at the spot I'd selected. It felt like I was playing Russian Roulette with all the chambers loaded.

The next day the heavy gang dug up the street.

There, sure enough, in the gooey mud, was a badly corroded cable with a crumbled hole you could shove your finger through.

Of all the happy moments in my life surely this ranked as one of the most ecstatic. I'd hit it on the nose. It was pure luck — but then, I'd prayed a bit too. I wanted so much to prove to Les that I could do something worthwhile.

I'll never forget this, my first cable fault locating episode. I'm sure that through this, my stock rose a bit in Les's eyes. You'd never know it, though, as he always greeted me with vigorously flung arms and many-lettered adjectives. This same event also helped me gain the trust of the heavy gang who had, over the years, dug up many 'dry-holes'!

I used the Wheatstone Bridge often after this, and found it to be most reliable. We had two portable units complete with instructions in the oak box-lid. These units are still in the Lab in Edmonton. Outside of being rewired they are going strong and doing good work. They are now about 50 years old, and had it not been for the heavy wooden cases, I'm sure that they would have fallen apart long ago.

I did lots of other work on switching equipment, but these few interesting jobs impressed on me the unforgettable rat-a-tat-tat of the old strowgers.



Dick Waters, Mike Cowell, Roy Bates, Doug Copeland, Scotty Milne with installation foreman Don Lynch in Lethbridge. (1955).

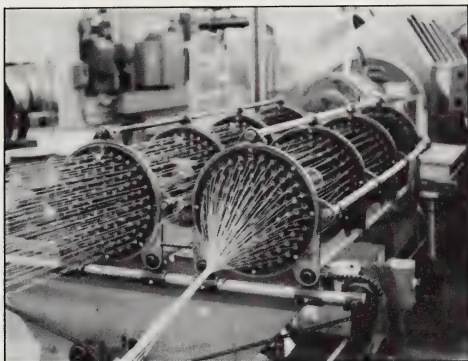
*Switching
Equipment —
One Step at a
Time*

Cable — An Electric Highway for the Telephone Signal

IT WASN'T long before heavily loaded open wire lines carried all kinds of high frequency signals along with the original voice frequency ones of days gone by. However, an expensive aesthetic problem soon appeared. The tall poles with their big fir cross arms and web of wires did not harmonize with the neatly kept lawns and well-constructed brick work of homes. The locals could see no reason why the unsightly lines (unsightly to them but a thing of beauty to us) could not end at the outskirts of town.

Well, telephone engineers were a step ahead, as they already had ideas for just such projects. They called this toll entrance cable. This was a high quality cable installed underground in ducts, or supported on poles overhead, held up by a stranded steel messenger cable.

It was the start of a new era in AGT Cable would be installed and conditioned for carrying high frequency telephone circuits. Toll entrance cable was often a composite cable carrying an



Phillips Cable Plant: Crowsnest Pass. (c. 1970)

assortment of high and low frequency signals, some of those which are listed below:

DC telegraph

Local voice frequency (250-3000 hertz)

'H' Carrier (5 — 10 kHz)

'C' Carrier (6 — 36 kHz)

'J' Carrier (36 — 140 kHz)

Toll Voice Frequency (250 — 3000 hertz)

Side and Phantom circuits.

The engineer's problem was to determine how to bring these signals through the cable, yet maintain good transmission for all facilities. This included considerations such as attenuation, frequency response, crosstalk, DC and AC, balance, return loss, impedance, noise and others — cable suffered many ills that affected these parameters. To control this necessitated such things as load coils, building out capacitors, and balancing capacitors — not to mention a big basket of telephone sense. We meggered, capacity balanced, and took return loss measurements by the dozens. Soon we were virtually able to smell out trouble.

This work started in 1952 — about the time Bob Taylor decided AGT was the company for him. He had graduated a couple of years before, and had worked in Installation for a spell. He was now eager to try out his slip-stick on a real live telephone problem in the Transmission section, and to apply a lengthy formula he vaguely remembered (having heard it as he drowsed through some fourth year lecture).

Bob was a great guy to work for, a most capable engineer who guided the transmission work of all toll and exchange cable. Later this included terminal and office balance.

Some of the many things I remember about working with Bob are two of his sayings. He'd often come out with: "Old Indian say; 'Don't

criticize young buck until you've walked a mile in his moccasins,'" or," Go ahead, do something ... it's better to make a decision and get on with the job even though it's not perfect, than to never do anything, because you're afraid to stick your neck out."

Taylor was a great guy for whistling, and you could always tell what kind of a mood he was in by his whistle because he always whistled a lot. I knew he was usually in a good mood. He'd work away whistling — the tune 'Mona Lisa' was one of his favorites. In contrast he'd suddenly break into a Taylor vocal rendition of 'Rattlin' Cannon Ball' ending with a gargle of 'Cowtown' yodel.

Bob spent his boyhood days living on the banks of the Bow in east Calgary. His back fence overlooked the rapids of that beautiful stream. Thus, he became an avid fisherman, and believe me, one of the best Rocky Mountain White Fish catchers I have ever come across. It's nothing to see Bob, in the fall when conditions are just right (especially up on the junction of the Red and the Panther), with three frisky little 'rockies' on at one time. I have viewed this with envy on several occasions.

Bob and I had a lot of laughs (and close shaves) driving the highway month after month. We'd head out in the old station wagon on a Monday and return on a Friday.

Numerous towns had toll entrance cables. These were places where we braved the frost, the sewer gas, the rickety ladders and the blow torch monoxide. We teetered with white knuckles on a cable splicer's board high in the air where some splice needed testing. I spent many hours on those boards with Splicers like Walter Cooper, Fred Waterman, Fred Pepperdine, Don Lane and Len Lenox, to mention a few.

Toll entrance cable was installed at:

Calgary — South, North, East & West

Edmonton — North, South & East

Lethbridge — North & East

Medicine Hat — West

Red Deer — North & South

Vegreville — East & West

Test equipment for this work included items such as the big three-piece 1B Impedance Bridge, the big 2A Audio Oscillator, and the huge 4A Capacity Unbalance Bridge. These all came in oak boxes and, along with numerous other oak boxes, were kept in our office. 1949 was the start of the present Engineering Lab.

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Through the foresight of people like Gib and Bob, we organized and set the stage for this present modern test facility, with its up to date test apparatus. They sold the idea ... I took it from there.

Later, Gib and I searched for someone to handle the technical side of things, and we came up with Martin Berger. He was then working in Exchange Plant Design under Bob Taylor (who had been transferred to help that endeavor).

The Engineering Lab has now become the nucleus of instrumentation for the Company.

Bob and I would start out from the office armed with loads of test equipment, various gadgets and, of course, gum boots. We'd head for some distant toll entrance cable. These were cables which the splicers had previously made ready, complete with loading coils, build out capacitors and balancing units. We would check the results mainly by taking return loss and impedance measurements. The cable was referenced, by the Return Loss bridge, to a precision network representing a particular type of cable and loading. We'd "shoot" any trouble we found.

The cable splicers, like other trades, were a clannish group of dedicated people. They carried

out the work of their choice, a seemingly rough gang who suffered the hardships of the elements. Cable work always had to be done when the rain was pouring, the snow was swirling, the wind was wailing, or the mercury had retreated into a blob at the bottom of the glass.



Len Lenox: Drumheller. (1952)



Line work: Vegreville. (1956)

Capacity balancing was necessary on the following types of cable facility:

'J' pairs.

These were non-loaded cable pairs. Balancing was done in large cast iron enclosures located at the open wire terminal or in the cable vault at the office. In this case, the cable was terminated in a 2A Binding Post Chamber directly over the terminal equipment in the office. The balancing box allowed balancing capacitors to be connected across any wire to wire combination. They were then adjusted to reduce crosstalk into that pair of wires.

'C' carrier balancing.

The pairs to be used for 'C' carrier were selected from widely spaced areas (bundles) in the cable, to afford as much natural isolation (thus crosstalk reduction) as possible. Capacity balancing enhanced this. The actual balancing

was carried out in the 'Silk and Cotton' splice in the cable vault. The cable normally terminates on the Main Distribution Frame (MDF). However, the outside cable was not taken this far. Instead a splice was placed in the vault downstairs directly below the frame, and a length of silk and cotton insulated cable was extended from this point to the MDF. The silk and cotton insulation was not as bulky and did not fray or unwrap as did the paper insulated pairs, which would happen at the frame termination. This splice (the junction of these two cables) was termed the 'silk and cotton' and was where 'C' balancing was carried out.

I wish to digress for a few lines and give you an account of what was called "protection cable". This was a short length of fine gauge cable (usually of 24 or 26 gauge). It was used as a junction between aerial and underground cable, and it acted as a fuse in case of sneak currents coming in on the overhead cable. Overhead telephone cable is subject to contact with AC power and DC street railway high voltage wires. It was much less expensive to replace the protection cable which was mounted vertically on the pole adjacent to both types of plant, than was to dig up the street because of a breakdown underground in the main cable.

To return to balancing cable pairs for the 'C' range of frequencies: the capacitors were made in the form of parallel wires wound on a heavy jute core. This assembly, called 'unit', came in lengths of about three feet. Each wire had very thick insulation, not to guard against voltage breakdown, but to reduce the wire-to-wire capacity to an appropriate amount. The capacity existed from wire to wire of this bifilar configuration. Changing the capacitance value was done merely by clipping off some of the end to reduce its length. This 'unit' ran approximately 25 mmf (micro-microfarads) per foot. Balance usually resulted by applying about one and one half to six inches of unit to the wires requiring correction. The crosstalk coupling loss requirement was in the order of 60dB.

The long lengths of unit (capacitors) came in cans that had a copious supply of desiccant to absorb moisture. It must be remembered that moisture was, is, and always will be, the cable splicer's dragon — to be controlled always. The cable splicer called these long lengths of capacitor 'Worms'. He would say to his helper, "give me a piece of worm", wherever balancing work was being done.

Careful adjustment, by clipping, would bring

the coupling of pairs to within allowable crosstalk requirement.

Voice Frequency circuits including Side and Phantom

There was also balancing to be done at voice frequencies — 250 to 3000 Hz. Crosstalk in this region was really worse than on a carrier facility, because it almost always caused 'understandable' crosstalk, meaning that people could understand what other people were saying on adjacent circuits. This was a bad thing — the secrecy of communication was at stake. Depending on how cold the winter evenings were, however, it could be looked on as entertainment.

Before I become involved with V.F. (voice frequency), let me clarify a few facts about phantom circuits.

A way back in time, not too long after Mr. Bell found a way of converting vocal pressures into electrical replicas that could be sent down a wire, experimenters and engineers thought up an idea for obtaining another talking circuit for every two pairs of wire that were of similar electrical characteristics. This was achieved by connecting a transformer across the end of each pair. By then connecting to the center of each secondary coil, another circuit could be established. It would not interfere with either of the other circuits. This was only if good electrical balance existed between the two facilities. If this did not exist, the main culprit was the capacity relationship of the configuration. Because the circuits came in through toll entrance cable, which always exhibits a lesser degree of balance than open wire, much attention had to be given to correct this. The new circuit was called a phantom.

It was roughly two thirds of the impedance of the open wire side circuits, in the order of 400 ohms. When everything was just right and you held your mouth just so, it worked like a charm.

Enhancing phantom balance in a cable often saw cable makeup using 4 wire bundles wrapped individually in what was called a Quad. This helped to control crosstalk coupling. Furthermore, once adjusted, it would not vary because the 4 wires were held rigidly in place.

Balancing this arrangement brought resulted in a complicated procedure, as 4 wires had to be taken into consideration at once. The 4A Capacity Unbalance Bridge was used for this. It permitted measuring the unbalance in adjacent sections of cable, so that Quads having comparable unbalance, but opposite polarity could

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be found in each direction. On connection, this resulted in neutralizing the unbalance of one section by the unbalance of another.

The capacity unbalance of the open wire was controlled by transposing the wires periodically. This used transposition brackets mounted on the poles or suspended in mid space. This arrangement physically turned the pairs over in relation to each other and ground.

All phantom office equipment also had to have electrical likeness for proper phantom operation. This was expensive and maintenance was high — however, it did make one more circuit possible on a heavily congested lead and brought in a few more shekels. A great deal of engineering was needed and our section played an important part in keeping phantom circuits smiling and happy.



Red Deer: Ray Simonson. (c. 1950)

If proper transmission was not maintained, subscribers had no trouble keeping up with the latest gossip, as they ended up having a most effective party line.

Phantom circuits played an important role, though, and certainly must be considered a stepping stone in telephone progress.

Along with the capacitive coupling of circuit to circuit, was the capacitive effect between the two wires of each circuit.

This had an adverse effect of high frequency signals on VF circuits. As the capacitive effect bypassed higher frequency signals to a certain degree, the transmission of signals over the band varied in amplitude in relation to their frequency. We called this effect 'high frequency roll off', or 'attenuation'. Something had to be done about this and it was the very purpose for which inductive loading was introduced into cable installations.

Loading is the application of toroidal coils (inductance). These have excellent electrical characteristics and are spliced in at a spacing that cancels the wire to wire capacitance of the pair. This turns the cable into a low pass filter with a frequency cut-off just above the transmitted signal range. It provides very flat response characteristics compared to the non-loaded case, and allows much better signal transmission over the range of frequencies.

When it came to a phantom circuit, it likewise suffered frequency droop at the high end, and thus required loading as well. The loading coils for this were a bit trickier, as the idea was to introduce inductance in a longitudinal fashion for the wires of the phantom, yet avoid introducing it into the side circuits. The opposite was also true — and all of this did add greatly to the number of wires coming out of the big cast iron load pots at the bottom of the manhole. Multiply by Murphy's Laws the number of wrong connections a cable splicer could make. The result is a situation whereby a 'splicer-of-wire' (and we) would never run out of a job.

The following list shows some of the loading we worked on. There were modifications to all of this, mainly because of the gauge used.

C — used for a carrier range of 6 — 36 kHz. This required approximately 4mH at an electrical spacing of 929 feet. B — this was used for program frequency loading up to about 8000 hertz. The coil inductance was 22 mH at 3000 foot spacing.

X — this was used for very short C carrier entrance cable or office cable, in this range of frequencies. The coil inductance was 2.7 mH spaced 680 feet.

H — this was used for V.F. ccts using 88 mH of coil inductance spaced 6000 feet.

Often a loading designation such as H31-18 would be used. This meant H distance using 31mH on the side circuits and 18mH on a phantom basis. The H referred to a spacing of 6000 feet between each loading coil.

Cable was “loaded” for another reason, as well as to achieve better frequency response over the frequency range. It was to bring about an impedance match between the cable and the open wire. Unloaded cable was in the order of 135 ohms impedance, whereas the open wire was 640 ohms. Cable loading raised the impedance to approximately this value, thus allowing good transfer of power and a minimum of reflection from the junction. This was important when matching a hybrid winding with a network to prevent repeater singing, and a host of other transmission ailments.

The actual distance between load points was always made a bit short of the distance that would equal the necessary cable capacity for the particular loading scheme. This allowed manual building out to the required value, and better accuracy of the overall scheme.

Cable balancing and loading always went hand in glove. I must say that Fred Waterman was one of the old stalwarts when it came to this. He was always chosen for anything new and different. I worked with him on numerous entrance cables.

In this particular case he had just spliced the Calgary north toll entrance cable, which included ‘C’ loaded pairs. However, my test results, instead of being nice and flat, resembled Pike’s Peak. Bob Taylor had previously taught me fault-finding for cases just like this, so I took readings every few kHz across the range and plotted them. By counting the peaks and determining the frequency of each, then by plugging the information into a formula, the distance to the trouble could be determined. The method also indicated whether a coil was missing, or if build-out capacitors were incorrectly connected.

Now, when my test information was applied to the formula, I came up with an answer that indicated something just had to be wrong. I felt like a gypsy with a crystal ball. I boldly told Fred there was something wrong 6 sections out and that he should look for a missing coil. Well, I have yet to learn how to tell an experienced cable splicer like Fred that there was something wrong with his work. Fred stomped around in a big circle that got smaller and smaller, as he unleashed some unsavoury, unfamiliar (to me) words he had pent up. He also told me that he usually ate a young guy from engineering every morning for breakfast.

He meandered out and ‘blew the splice’. I was sitting on the platform with him when he opened it, and the splice was neat and tidy (Fred always

turned out a good looking job). But when we dug down to the pair in trouble, the wires went right through. They were not spliced to a coil at all. Cursing under his breath, he fished out a couple of unused leads from the ‘load-pot’ and connected them to the cable pair in question.

I went back and tested the pair. Things were different now! I had nice flat return loss and a glow inside that warmed me more than a dram of Scotch could.

Fred didn’t say much, but he eventually came up with a couple of remarks along the lines of, “OK, you wise guy ... ya just can’t win ‘em all.”

He closed the splice and the truck roared toward the garage.

I always figured you needed a suitcase of luck along with you for situations like this. The ‘Old Timer’ really didn’t know just how good you were. It was a bit like playing poker — I know I certainly played my cards close to my vest anytime I ‘called their hand’. The odd time I hit the nail on the head, however, they always had some well-phrased rejoinder.

Really, all I did was follow the instructions as outlined in the practice — and if I did things right, it worked. I had many chances to apply the impedance irregularity location formula from then on, what with Red Deer, Lethbridge, Drumheller, and so on. It worked like a hot darn.

Walter Cooper did the Lethbridge cable. I spent two months on his ‘cableboard’ swaying in the air, assisting him to find troubles. When Fred Waterman came down, we then worked the underground over.

It was the coldest winter I have experienced. There was five inches of frost on the inside of each manhole. Our only heat was the old gasoline blow torch which we kept going by the hour. It still rings in my ears and I’m sure I still have traces of its fumes in my lungs.

I think it was about this time that Bill Meyer was blown out of a manhole in Lethbridge when gas in the hole exploded. He was quite badly hurt.

I remember other cases when there was a strong smell of gas. Often a manhole cover would be taken off some distance down the line and, if the ducts were not plugged, the draft blew gas fumes along the duct to the hole you were in. These things didn’t bother the cable splicers much; they’d just open the hole and clamber down. I was always edgy, though, after hearing about Bill’s experience.

Some of the Splicers I did cable work with



Don Lane and Guy Hamilton. (c. 1955)

are: Fred Waterman, Don Lane, Len Lenox, Walter Cooper, Robby Stronach, Gordy Stanley, Al Hosie, Bill Cordingley, "Jigs" Poyle, Cam Campbell, "Pep" Pepperdine, Jim Swain, Dennis Bateman, Barney Moffat and Jack Orritt. There are numerous others that slip my memory ... my apologies.

In those days, everything was done in lead. The cables were lead sheathed, so the splice at the junction of the two cables was fashioned by putting a lead sleeve over the join. The ends were 'beat in', then molten lead (hot enough to bond the sleeve) was poured on top of this with a ladle. A wiping-pad was then used to form the molten lead into a neat contour, thus joining the sleeve to the cable sheath. More lead was applied, just hot enough to be putty consistency, and too was wiped into place. The finished job was really something to behold. The ends were bell shaped, with neat little markings made by the strands of the wiping-pad. Any excess lead was wiped off, then usually the cable splicer artistically carved his initials into the lead (likely in old English script), indicating to all that he was the creator of this treasure. It was not too different from artists who likewise sign their works of art, sort of throwing a challenge of artistry to the world. There was an art to wiping a joint. If the lead was too cold it would not permit manipulation and molding it to form. On the other hand, if it was too hot, it burned the sleeve and the cable sheath — then there was real trouble.

Every once in a while, even the best cable splicer came up with a bad splice. He would often try to patch it, but you could tell a patched splice from across the street.

However, I have yet to run across a cable splicer who was not a bit of a practical joker and

not to be out done, even by a terrible looking wipe! Why not just carve his buddy's initials into the splice? After all, the buddy was likely doing the same thing to one of his own poor ones. There were always streams of accusations, much stomping around, and even a bit of swearing, whenever this was found.

All of the wire-insulation in the main cable was paper. This sopped up moisture like a week old hot dog bun. Every effort had to be made to avoid splicing damp pairs. A good splicer could tell right away if the paper insulation was all right by handling the paper. If it didn't rattle, then it was too damp to splice. It was a test that was always made.

One of the means of driving moisture out of the paper insulation was pouring molten wax over it. The temperature of the wax was critical and a test was used to determine when the temperature was just right. The wax was heated in a large pot over a burner, and a piece of brown paper was then dipped into the wax and held erect. If the temperature was right the wax would quickly climb up the paper leaving a clear coated area that you could almost see through. If the wax would not climb, it was not hot enough. On the other hand, if the wax was too hot, the paper would be charred.

At the right temperature, the wax was ladled onto the pairs. Starting at the place where they protruded through the sheath, the wax was worked towards the end of the wires, driving the moisture ahead of it. The waxed coating then prevented the absorbent paper insulation from picking up additional moisture. This procedure was called 'boiling out the cable'.

When I first started to work on cables, it was with Fred Pepperdine ("Pep", as everyone called him) and Fred Waterman Sr. Fred taught me many techniques that were used by the splicers, to the extent that I could have hung up my own shingle as a splicer. The toll pairs were twisted and soldered, but the exchange ones were merely twisted together. I was interested in another approach that Fred told me about. He said that at a previous time the spliced wires of toll cables were welded instead of soldered. I was intrigued with this technique and have since used much the same method for silver soldering at home. I'll explain the method as told to me by Fred.

A source of low voltage, high current power was used, such as a car battery. One of its terminals was connected to the two bared cable wires that had been twisted together and snipped off.

The other terminal of the battery was connected to a block of carbon. By gently drawing the ends of the wires across the carbon block (thus completing the electrical circuit) an arc was formed. The wire ends were in this way heated enough to cause a small bead of molten copper to form on their ends. This welded them together. It was a quick way of making a very permanent and clean electrical connection and all important cable pairs were connected in this manner. It is not used today, as soldering has taken its place.

One day Art Davis received a phone call to the effect that a working 1200 pair cable in the Main Exchange was suddenly unusable because of high electrical noise. He asked me to investigate.

I headed to inspect the cable vault at the Exchange, as I knew some 'splicers' were working there. When I arrived, I found that one of them had left his buzzer connected to a pair and had gone to a nearby manhole to locate the pairs at that end. Now, buzzers turn out the most gosh awful bunch of noise you've ever heard, and this guy had even put on extra batteries to make sure the signal would get out. It got out alright — it coupled into 1200 pairs of cable, and all calls were instantly jammed by the noise. No one had a snowball's chance of placing a call over that interference. I cut the buzzer off, and then explained a few facts to the splicer about crosstalk and buzzers on cables, etc, etc.

It didn't take long to get instructions out regarding the use of such apparatus on cables.

Bert Fearey Sr. was likely the best cable splicer AGT ever had. He spliced the uprights in the old Calgary main, and these were without a doubt the nicest splices I've seen. Verticals are always harder to wipe, because the molten lead has to be carried to the splice on a pad — it can't be poured onto the splice with a ladle. If it wasn't done just right, the molten metal would run all the way down to your arm pit, resulting in much cursing and stomping around, all the time with a death grip on your arm and the smell of burnt hair and flesh.

While on the subject of cables, I must relate an incident that happened when I was testing the Edmonton South toll entrance cable. We'd set up for testing at the terminal pole, when a small yappy dog came running past the truck chasing a wide-eyed cat. The cat was holding its own, but apparently along the way made a mental calculation which triggered its climbing mechanism. It must have said to itself, "Why not tear up that telephone pole?"

In a flash, that's exactly what it did. The pole was about 45 feet high, and the cat was well out of reach of the dog, which soon became stiff necked from looking up and ambled off. We were amused at the incident but found out later that the cat was stranded. It apparently hadn't been schooled in how to climb down off tall poles. At any rate, it was doing a lot of meowing and glaring down at the ground.

We were about to leave, as it was quitting time, but didn't know what to do about the cat. Finally I donned a pair of spurs, belt and gloves, and started up after the unhappy ball of fur.

It took some time for me to reach the top as I was about as scared as the cat. At last I found myself about three feet from the top. I anchored myself and reached up with a gloved hand for what I thought would be a very grateful cat that would show its appreciation by purring.

I grabbed a leg and tried to pull it close to me. Instantly I had a snarling beast, furiously clawing in defense. The purr, if there had been one, now sounded like the snarl of the wilds. The cat became a steel spring, all legs gyrating, straining to get away. At that moment it decided to go on its own. Struggling free, it prepared to jump. Using my head as a launching pad, it dug in, then leaped to the ground.

There was a leaden thud. The cat lay stunned, as flat as if pressed by a steam roller. Gaining its senses, it streaked for the underbrush.

Me? Well, I still have a scarred scalp and, dammit, I have no sympathy for stranded cats. I feel that if they get trapped, they're on their own.

Cable loading and balancing certainly took a great deal of my time, as I was given the job of looking after all of the toll entrance cables and office loading. Bob had started the work, and I succeeded him. Our principal loading was for voice, side and phantom, using H 31-18 loading, and 'C' loading for the 'C' range of frequencies. X2.7 loading was used for short toll entrance, for instance at Ft. McLeod, and the Calgary toll office.

I remember doing that job under the direction of Lee. I adjusted all the capacitance build out, based on the measured cable capacity, then found that I had to do the job over because I hadn't taken into account the coil capacity. The coils had to be measured, then the amount halved and added to each side of the span capacity of the cable. We did a lot of learning as we carried out our work. Every job seemed to have a new wrinkle.

To complete the general transmission picture, I must mention Resistance Design and Subset Zoning. These were two design criteria that were included to make end to end transmission pleasing to the ear and bring a happy countenance to the users of the telephone box.

'Resistance Design' was a method that enabled the efficient use of cable. Certain rules were laid down based on a 23 milliamp DC current. This was a value that would adequately operate switching apparatus in the local exchange. Design was such that 26 ga. cable (very fine) would extend from the office for 15kft., and from there, coarser gauge would be used up to a length of 18Kft. This provided a considerable copper saving. If further distance was needed, then H88 loading was applied, as transmission would tend to slip beyond this length.

Step by step offices had a 1300 ohm resistance limit using a 100 ohm temperature allowance, which gave an allowance of 1200 ohms.

Number 5 X-Bar offices could operate up to a 1500 ohm limit.

Shortly after we became involved in office terminal balance we found that cable plant had another dimension, called the average cable impedance. It was a representative figure of characteristic impedance which a hybrid transformer would see through switching equipment. The Bell Company had suggested 900 ohms. We soon carried out tests (at Olds and Wetaskiwin) to determine if this was representative of AGT cable plant. The old value was 600 ohms. We agreed with the 900 ohm figure, which resulted in a basic network termination of 900 ohms non-inductive resistance with 2 mfd's of capacitance in series with it. The capacitance was needed to represent the 2 mfd (series) capacitor used in the trunk coil for matching the 600 ohm carrier equipment to the 900 ohm cable facility. The capacitor in the coil was used for DC blocking, being connected in series with the midpoint of the line winding. This allowed 48V battery to be applied to the circuit in the subscriber direction.

Subscriber set zoning was employed in the 50's, and is not in use today. This was a way of assigning the various types of telephone sets, with different degrees of transmission to predetermined areas. It allowed transmission from any place in the city to another to be about equal. The hitch was that because sub sets had to be installed at increasing distances from the office (the source of the voltage), the transmitter current became less and less. This caused

lower speech volume. Because their carbon transmitters wanted lots of healthy electrons (which in this case were just not there), many times the sets went 'Terminals Up', as they couldn't produce much more than a feeble, tinny signal.

The old 300-type Northern Electric telephone sets were very basic and required ample current. For this reason they were installed close to the exchange. The new transmission-compensating Northern type 500 and AE Co. 80's could be used further out, as their circuitry automatically adjusted the DC current, creating uniform transmission over a wide range of distance.

I made up zoning maps for all of Calgary along with several other centers, then assisted in keeping track of zoning. It wasn't long, however, before the 300's were phased out of the network and the compensating telephone came into use. With it, zoning faded into the past — much to everyone's approval.

I suppose cable will be with us always, but even it certainly has seen changes. The old paper-wrapped insulation is almost a thing of the past. By the same token, lead sheath has now been replaced by plastic. The splicing ways, too, have seen drastic changes — all in the interests of job efficiency and service.

Toll Centering — “The Communications Hierarchy”

IN THE winter of 1952, Mr. Gaudette of Bell Telephones came to Alberta to give a series of lectures on what was to come in the future.

This was really the start of today's modern telephone network.

A plan was created that would change the old network to one that would be based on the use of Toll Centers. These offices would be established in a plan of hierarchy. There would be 18 “Class 4” offices located at strategic points throughout the Province. End offices (Class 5) would connect to each other, via the Class 4 offices. In some cases this would create a problem: as longer telephone lines were needed, trouble would be more likely to occur. On the other hand, there would be no more butting-in or eavesdropping, and darnit, this meant the loss of a long-standing source of rural entertainment, especially on cold winter nights.

The new method of network operation was necessary for Direct Distance Dialing in the

not-too-distant future. The whole program was to become known as Toll Centering, based on V.N.L. (Via Net Loss) operation of all trunks. Trunk Design was such that it would not exceed 2.5 dB loss. This allowed good loud hearing, something to behold, especially for rural telephone users. Transmission would then be standard throughout the Province.

Mr. Gaudette's course was most interesting, and certainly opened our eyes to what was in store for the future telephone network.

Art, Gib and I came from Calgary to attend. It was a very cold January week. We stayed at the Corona Hotel.

I remember that each noon, Gib insisted on walking the six blocks to the Corona Hotel to play cribbage. I figured he was a cribbage nut, but anyway I went along. Could he ever rattle the cards! He knew every count at a glance. I'd occasionally hear him muttering away even when he was driving along the road, "Fifteen-two, fifteen-four, fifteen-six and a jack ..."

He'd often suggest having a quick game at some near-by repeater station, and we'd keep score in the dust on the floor.

We'd play for 2 bits a game, and I used to let him win a bit just to keep him going. I've since told him about this, but he denies it and stomps around shouting that it was he who used to let me win. He carried around an old beat-up crib board in his brief case, made out of some forlorn deer's antler. The pegs were two rusty nails and two old cotter pins.

Not much time passed before some of Mr. Gaudette's points started to shape up. We went into a Toll Centering plan complete with V.N.L. designed trunks. Calgary was assigned Class 2 status and Edmonton Class 3. There were indeed 18 Class 4 offices, and all the other Class 5 offices homed in on them. The next phase was transmission level adjustment of the network for true V.N.L. operation, to allow optimum control of echo.

The advent of Direct Distance Dialling made it imperative that offices were electrically compatible, as all circuit switching was now automatic, under control of a finger in a telephone dial or a peck on a push button.

The most important factor had to be the economics of the whole operation. Understand first, that all long distance trunks were effectively 4-wire, as that is how a 'carrier' works. They were then converted to 2-wire, for switching or connecting together at switch points. This is the

subject of the next chapter, 'Toll Switching Equipment'.

The guide for toll centering and D.D.D. operation was a set of instructions titled "Notes on D.D.D.". They soon became the telecommunication 'chapter and verse' for the design of this modern network.

Everything in telephone design, as if told "On your mark, get set, go!" really took off at this point. As though it had been restrained on a leash, each element of the telephone network now surged with improvement in a chain reaction. The result was quality transmission linking remote hamlets, towns and cities throughout the Dominion.

Toll Switching — A System of Electro- mechanical Wizardry

IT BECAME became evident at the time of Toll Centering that toll switching machines would be needed. It was decided that Calgary would get a new one called the Cross Bar Tandem. But what about Edmonton, with its Siemens switching machine that wasn't very old? This machine was quite different from the rest ... it was a true 'four wire switching' machine, different from the North American switching concept. A toll switching machine is one of two kinds: it either switches four wires at a time through the office, or it switches two wires at a time through the office.

A 4-wire set is composed of a hybrid transformer, pads and 'A' and 'B' DC feed circuitry, basic network and build-out capacitors.

A 4-wire switching machine connects the incoming and outgoing V.F. paths of two opposite carrier channels together, via a 4-wire set associated with each channel. This requires duplication of switching equipment to switch the network leads as well as the line. Because four

wires are carried all the way through the machine, this results in virtually a double-sized unit at a corresponding increase in cost. It has one main advantage — it is self-balancing, regardless of the length of the cabling in the switch path.

The 2-wire switching machine is smaller because it only needs to switch two wires. This makes it cheaper, but there is one important factor: to realize two wires from four wires involves the use of a wire set for each circuit that must be manually adjusted. Balancing a 4-wire set reduces feedback, and thus echo, which is very important.

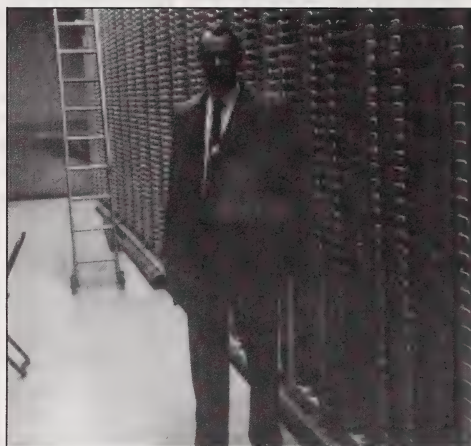


Red Deer: Harold Cooper. (1954)

A maximum of 7 links is permitted in the toll telephone network across Canada. This means that at 6 locations the 4-wire carrier must be changed to 2-wire, by a 4-wire set. If the 4-wire set is not adjusted properly, some of the outgoing signal will be reflected back through the toll circuit. This signal would be treated like a 'wanted' signal and travel all the way back to the ears of the talker, making him hear his own voice. The returning signal, however, suffers considerable time delay; the returning signal sounds like an echo. Tests have been made of this effect and show that too much echo makes talking very difficult. It is therefore important to adjust the hybrids to a good degree of balance. We did this at all switching offices. The first place to undergo terminal balance was Camrose, which Bob Taylor and I carried out.

In addition to the long distance circuits that needed an assortment of connections by switching machines, were the myriad of toll connecting trunks. Adjusting the balance of the hybrids in the toll office as mentioned above was called "Office Balance", which required 27 dB. At the subscriber end, where local switching also had

to take place, the balance requirement was 18 dB. These toll connecting trunks were also reduced by at least 2 dB to further reduce speech echo effect. This extra loss results in 4 dB of control because an echo signal gets a dose of loss on the way out and another dose on the way back — good for echo control, but something that had to fit into the overall transmission plan. Otherwise, the signal would become attenuated too much (and who wants a telephone signal that's on its knees?).



Calgary: Morley Turner. (1959)

A case of poor hybrid balance in Alberta is heard as echo at a distant place — down East for instance; poor balance in the East would be heard as echo here. Office and Terminal Balance required many months of work. We developed our own methods for the adjustment at some offices.

While I can't think of any particular events that cropped up while balancing an office; I know it provided a good electrical 'house cleaning', because a return loss measurement shows up transmission troubles like a hot darn.

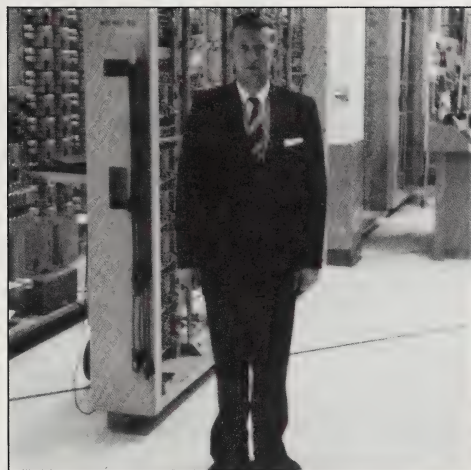
One episode I remember occurred sometime later during terminal balance adjustment in Stettler. Case Plaas, who worked for me at the time, was doing the job. While testing the Gadsby circuits he ran across one that sounded pretty feeble. He tried to talk to the operator at the far end but could barely hear her. He remarked to the local Stettler staff that the circuit was not too good — the answer he got was to the effect that it was because the operator was a little old lady who didn't talk very loud. It had been like that for years. Case still thought there was something wrong and went probing. He pulled

out prints and manuals and traced the circuit bit by bit. To his amazement, he found that the repeating coil for the circuit did not have a capacitor wired in at its midpoint. One side of the coil was open circuited, introducing all of 30 dB of attenuation into the circuit.

"Can you imagine the look on the face of the little old lady at Gadsby on the next conversation, after a capacitor was connected?" he asked.

We can assume that she came to attention with startled suddenness, and had a loud ringing in her ears for days.

Numerous other problems were found through doing terminal balance. Grande Prairie was found to have all CLR trunk coils connected in longitudinal fashion, introducing an extra 6 dB of loss. The local report was that Grande Prairie was always low in volume on toll calls. It certainly 'talked up' after proper connection.

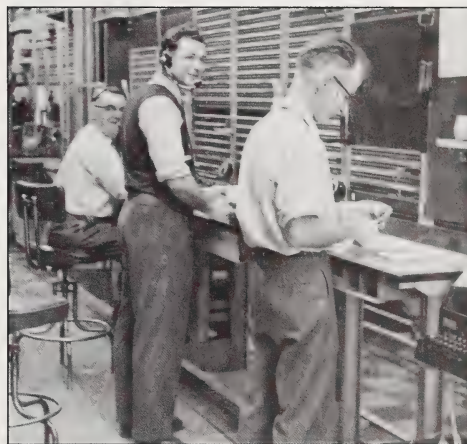


Lethbridge: Darwin Walkingshaw. (1957)

In Calgary, all of the coils in the Toll Switch trunks were found to be reversed, and so on. As I say, it made for a real clean-up, along with its main purpose of reducing echo. I estimate that, in the 10 years we carried out our transmission trouble-shooting campaign, 25% of the work had to do with hybrids: three-winding transformer hybrids, resistance hybrids, miniature hybrids, build-in hybrids, special hybrids; and then the Siemens hybrids, which were a type all of their own, using variable potentiometers ganged together for each send and receive attenuator. They had a tracking problem. Others had plug in resistors, (NECo), while some used strappable resistors (Lenkurt) to change the value of the pad. We had 900 ohm

hybrids, 600 ohm hybrids and special hybrids with A and B leads.

The Siemens switching machine in Edmonton was another story. I mentioned previously that this system switched 'four wire', meaning that it extended both the line and network, which resulted in switching the four wires. A North American 4-wire switching machine extended only the line wires, leaving the network terminated. The Siemens switching method, on the other hand, carries the network lines along with it and is called a 'Tail Eating' connection. I don't know where the name 'Tail Eating' came from, but then, the boys from the land of cocksles and mussels also drive on the wrong side of the road.



Edmonton Toll Testboard: Harry Allen, Ralph Davison, Dave Kirk. (1957)

In an ordinary 4-wire switching machine, the hybrid is balanced by a network that is electrically equivalent to the impedance connected to the line winding of the hybrid. In doing so it uses up half of the applied energy (3 dB) in its network. In this case this is the price we pay for hybrid balance. Once the network for the hybrid is adjusted it is never touched again unless the switching path is altered. The signal, in going through the hybrid, suffers a 3 dB splitting loss along with other incidental losses due to coils and the like. This results in a total loss of about 3.25 dB.

In the case of the Siemens switching machine, the hybrid line terminals are extended to the corresponding line of the other hybrid through switch contacts, with the network connection carried along as well. In this way, the power lost in the 2-wire system in its network termination

is now combined with the power of the line circuit, thus creating an increase in signal level. The Siemens method offers continuous balancing of the hybrid, and allows this power increase of 3 dB. The cockles and mussels boys were right on ... the principle is sound, but to marry this English system to a North American system brought many Canadian problems. Many of these made months of work necessary in the Edmonton Auto Toll Switching room. I got to know a lot of the guys through this; a few names stick in memory: Dave Kirk, Don Wallins, Art Parson, Julien Tremblay, Ralph Davison and Derry Ingram.

Yes, Toll Switching followed the pattern of the old strowger stepping switch, which connected a signal through an office in a sequential

way; but in this case connected toll to toll (instead of exchange to exchange or subscriber).

It is interesting to note that the initial Strowger switch was the invention of an undertaker. He fashioned a rotary switch from a man's starched shirt collar, using pins spaced around in a semi-circle to make contact (it seems he felt the local switchboard operator was swinging business to his opposition across town). From this crude rotary switch device developed the basis of most toll and exchange switching machines. Now, of course, these are surpassed in every way by an astonishing array of electronic apparatus — a far cry from that meagre beginning.

Line Troubles

WE ALWAYS seemed to be involved with open-wire troubles ... some were real dillies.

We even developed a soft spot in our heart for pole lines. True, we didn't construct them, or do much repair, but we did plenty of special testing on troubles.

I remember working at Brooks one day. A big black dust storm sneaked up on us. The carbon blocks on the main frame soon twinkled like Christmas tree lights because of static electricity on the wires. Now, most of the blocks break down at 350 volts, so the static charge was well in excess of this. From time to time since then, I have measured several hundred volts between the wires on a pole and the ground, on a dusty day.

Whenever we drove along the road, it became automatic to record the location of insulators that were missing or cross arms that were tilted because of missing braces on poles. Vaughan Monson told

me that one of the jobs he had the winter of 1954 was to travel from Calgary to the Saskatchewan border and check the location of every 'J' transposition, its general condition and other things about the lead. Bert Standing, of the Plant in Lethbridge, helped him.

We always seemed to be chasing the elusive V.F. crosstalk; we used the 5B crosstalk networks. These were well-balanced coils that could be connected to two pairs of wire to make a phantom circuit. The main troubles seemed to be caused by a poorly made micropress connection. It is a small phosphor bronze sleeve which the large copper toll wires were placed into from each end. The sleeve was then crimped to tightly grip each wire. There was however, one requirement: that the wire be clean and free from the familiar oxide coating before it was inserted into the sleeve. Often this was not done, and after a period of time it resulted in poor electrical connection. In one case, we had a very loud radio signal on the telephone lines. It was found to be caused by just this, a poorly made micropress connection. When we checked the micropress sleeve, we found it to be about 25,000 ohms in one direction and 100 ohms in the other. This acted like a diode, and rectified all kinds of extraneous signals, thus causing noise on the lines.

Corroded fuses often caused the same trouble, especially in areas where a corrosive atmosphere existed, such as Turner Valley. Sometimes transpositions would be cut in wrongly, or a guy-wire found to be touching a signal wire. Hum, crosstalk, noise, poor volume and radio station pickup were all ills the telephone message suffered because of the various telephone germs. For the record — Lee Harrison's first job on coming to the company was to determine the cause of crosstalk on a phantom circuit from Okotoks to Turner Valley. He found it to be a badly corroded open wire splice.

Once, Harold Johnson, then the lineman for Calgary West, had a case of trouble that puzzled him for several weeks. This was an intermittent 'short': a Varley measurement at the toll test board showed the trouble to be about 25 miles out. Harold patrolled the line many times but all was in order. Each time when he arrived back in town he was informed that the trouble had once more flashed on and off within the last few moments.

Out he went again, but all was clear. Then he saw a huge hawk had a happy home well

placed on a transposition bracket. Every time the bird sat on the nest, it lowered the wires to a position that allowed them to touch together. Harold just went down the road aways, climbed another pole, and tightened the wires with a pair of jack straps. The hawk likely never knew the difference except that its mattress was not quite so springy. He left the big bird to the lulling strum of the telephone wires. Just think — today there may be a strain of hawks flying around with a steady drumming sound in their ears.

A problem once cropped up which was brought about by the atmosphere near oil fields. The corroding effects on copper wire often aggravated poorly-made wire splices so that they became rectifying connections. This meant that it became 'polarity conscious': the connection would allow more current to flow from positive to negative than negative to positive or vice versa. Now this is exactly how the old crystal radio set worked — in technical terms, it demodulated any radio signal that was present, so it could be heard loud and clear on a pair of earphones.

In this case, it so happened that the Turner Valley district had all the ingredients for this interference. There were long open wire lines in close proximity to the radio stations CFCN and CFAC, and telephone lines that extended from Calgary to Turner Valley; they were near many open-pit gas flares which did not improve the already corrosive atmosphere of the oil field.

Any twisted wire splice that was not well soldered, a poorly made micropress connection, a loose fuse clip for a 5A fuse on a 98A protector, or even a bad ground connection could easily exhibit a nonlinear characteristic, especially after lengthy exposure to such an H₂S oil field environment. The music of CFCN then burst in with the clarity of the best radio set. All you had to do was pick up a phone in the area and you had an instant radio program or your favorite 'soap opera' as a background to your telephone conversation. This wasn't too bad — except that they both came in together.

We had many calls to clear radio music from telephone circuits in the Turner Valley district. It usually required careful inspection of the open wire line. I once found a trouble of this nature to be a badly corroded fuse connection right in the Okotoks office.

Later, I had a case of music on the wires south of Edmonton. It also proved to be caused by a corroded micropress sleeve on the open wire connection. This time CFRN blasted in on the telephones.

While on the subject of unwanted signals on telephone circuits, I'd like to mention another problem that really made us do some head scratching. We had been given a report of interference into a 'C' carrier operating from Edmonton to Red Deer. Art Davis asked me to carry out crosstalk tests on the open wire to try to find the source of trouble. I tested all the circuits but found nothing that would cause the trouble.

"Well, if that's the case," he said, "guess there's just one thing left. I wonder . . . what about that Calgary Power High Voltage Line located on the other side of the road?"

Art asked me to contact D.O.T. (I think Jake Allen was in charge at the time) and borrow a receiver that would tune down to approximately 20 Kc. I then rigged up a crude antenna, suspended it near the power line, and started tuning. Amid the assorted beeps, crackles and squeals, we came across a very strong signal with modulation on it. It had that characteristic 'single side band' sound, so we injected carrier by putting the receiver in the CW mode. Then we carefully adjusted the 'beat frequency oscillator control'. Lo and behold! There was talking, loud and clear, coming from the high voltage power line.

Calgary Power had installed a 'power line carrier' on their transmission line and it was coupling into the telephone wires. It happened to be a frequency the 'C' carrier was quite happy to receive. I've forgotten what Art did to remove the interference — but it was certainly a different case of trouble.

On another occasion interference occurred at Peace River. Apparently there was bad crosstalk in a cable carrying RCMP messages. The police transmissions had been broadcast all morning over a considerable area of the countryside, by the radio station. I found this to be an almost instant way of getting cable trouble fixed.

Telegraph was another headache, as telegraph signals and cables don't get along at the best of times. I remember Don Hunt (sometime later) having a long battle with telegraph signals in a cable at Elvedin House (high rise office building) in Calgary.

Fluorescent lights were another source of trouble. We once had a case of frying noise into telephone equipment from nearby 110 volt AC power wires. Another time fluorescent lights were located immediately in front of the 'O' carriers. This produced a lot of hum, a lot of hash, and a pile of disgruntled customers whenever lights were turned on.

Another time, shortly after the Milk River 'J' station was cut in, the open door alarm would often burn in the Lethbridge toll office. Each time this happened it required a trip to the repeater station to check if all was well. Everything always checked out OK.

After several such trips, the fellows went out and camped a short distance from the station, and waited with spy glasses for some culprit to come along. All they noticed was a few gophers, two rattlesnakes, the odd curlew and the train thundering by. They phoned in, for kicks, and were immediately told that the alarm had just sounded. After a lot of head scratching, they came to the conclusion that the train was the cause. Sure enough, the microswitch on the building door was barely making contact with the door jamb; when the train went by it jiggled the building, allowing the switch to actuate, thus sounding the alarm. A screw driver soon fixed that, and we put an end to the train engineer's fun — even if he didn't know he was having any.



Transmission office: Bob Taylor, Jack Kirk, and Joyce Ward. (1958)

Happenings in the Field — Keeping the 'dBee' in Line

OUR WORK under Russ Crawford was Transmission Improvement. Russ had, for a long time, in the back of his mind, a solution to the deplorable state of voice transmission throughout the telephone network. He was the Transmission Engineer; it was his responsibility to make sure people could hear very well on the telephone. The following things certainly needed attention:

- Noise
- Crosstalk
- Attenuation of the Circuits
- Electrical Protection
- Office Ground Systems
- General Condition of Switchboards and Switching Machines from a Transmission Standpoint.

The work was to be carried out by our field force in Calgary. With this cleanup in mind, Art started me off in 1949 on a Province-wide transmission improvement campaign. He gave me a short familiarization course with various



test equipment; assigned me the black Chev Panel #44; unfolded a large toll map and, pointing in a southerly direction, he said, "... GO!!!"

Norm Blamire was brought down from Edmonton to help me. We proceeded down each telephone route, stopped at each office, went through our tests, fixed as many things as we could and made notes of other problems that were larger or more complicated. At the end of the toll route we would cross over to the next one, then start back once more, testing and fixing things along the way.

We soon had long lists of missing insulators, leaning poles, improper transpositions, poor grounds, bad crosstalk, noise, worn jacks, poor roads, missing bridges and a complete account of the menus of all the Chinese restaurants in Alberta.

We met many seasoned telephone men who were most skeptical of our purpose and abilities. Some watched us every minute as we soldered or changed out cords and the like. A few would

not allow us even to come into their offices (at least not until a phone call to Art confirmed the purpose of our visit). It was difficult to impress upon them that we were out to try to improve things — not to check up on them.

We travelled every type of road in all types of weather. We spent many hours slithering around in the mud, putting tire chains on. We saw the telephone in all of its forms of construction and operation.

In one place, Bluesky, someone substituted short lengths of .104 copper wire in place of the proper 5A fuses in the protectors because they kept blowing. Another place used the fuse-blocks as a place to pile magazines and junk on. It was hard to identify the fuses as the dust was so thick. One farmer became tired of breaking telephone wire when he took his farm implements across the road. He cut the telephone lines and fastened them to a long board which was fastened to a 2 x 4 he'd nailed upright on the gate post. The wires from the other direction were terminated in a similar

fashion. The ends of the respective pairs were merely hooked together 'U' bend to 'U' bend — a very convenient way of disconnecting the telephone lead (but at the expense of noise and poor connection on telephone circuits). Some farmers even tried to repair the line themselves by using old bottles for insulators when the originals became broken. The odd time we came across nests of contented crows that had built their domicile on ready-made foundations of a transposition bracket, close to the drone of a telephone wire.

In our travels of Alberta (and we covered all toll routes twice), we saw things of interest like the Brooks aqueduct. There was breath-catching scenery at the junction of the mighty Peace, mighty Smokey and placid Heart River, where they saunter together near the town of Peace River. Then near Grande Prairie, there was Saskatoon Mountain and Bear Lake with its autumn frenzy of water fowl. Herds of antelope grazed unconcerned on good old prairie wool on the game preserve near Medicine Hat. We saw Turtle Mountain, where in 1912, a mighty chunk of rock thundered to the sleeping valley below, smothering the village of Frank, near Blairmore. There was the grandeur of the Rockies at Banff and Jasper; the oil fields of Turner Valley; the Handhills of Delia; the badlands of Drumheller; then the drilling rigs of Leduc and Redwater; McGregor Lake, the water supply for the network of irrigation at Brooks.

One day, driving along at Slave Lake, we saw an Indian standing on the side of the road in the pouring rain sawing away on a violin: it was the awfullest screeching noise you ever heard. (He was likely banned from teepee, compound and tribe.) Just think, the poor guy might have become a great virtuoso.

One day when Bob Meikle and I were out on transmission maintenance work, we ran into a pack of trouble at Smoky Lake. The old 1260 switchboard had a couple of keys that were acting up. This was 'old hat' to us, so we decided to fix it right there. We lifted the key shelf to get at the wiring ... immediately things stacked up against us. The switchboard went completely dead. We finally connected a 'Federal set' (portable telephone set) to one of the 'toll leads' to allow communication, then worked until four in the morning to get the board going again. The old insulation on the wire under the keys was so brittle that every time we touched it, something shorted out.

We sweated blood and tears over that old board ... it's the kind of a job that doesn't help your reputation.

Bob Meikle and I travelled hundreds of miles together and had many good experiences. Bob was a great story teller. He could tell some of



Transmission Maintenance: Jimmy Green, Bob Meikle. (1955)

the best jokes I've ever heard — he really put action into them.

One day we travelled to Lloydminster. Reg Skitch (one of our favorite personalities) was there at the time. We told him that we had come out to do some transmission testing. Reg insisted that surely we were not going to interfere with his plans for the local sports day that was already in progress (especially the baseball game which he wanted to see). He persuaded us to go out and help cheer the local team on. We were leery about this — but it didn't take too much arm twisting, and off we went to the ball game.

When we arrived at the gate, Reg announced to the ticket taker that we were there to fix the phones. The man at the gate insisted that the phones were working fine. Reg was a good talker, and threw in some telephone jargon that immediately gained us entrance. After all, they

wouldn't want the sports day to fail because the volume was down half a 'deeBee', would they?

We had a very enjoyable afternoon, and the local team won, which elated Reg. We always had a lot of fun with Reg when we went to Lloydminster.

Another place where we liked going to was Vermilion: Jack Reid was there. He used to fill us in with tales of days gone by, and some were pretty tall ... I still wonder about them.

Jack Scott, at Vegreville at the time, was another person we got to know very well. We heard many elevated tales of telephone fantasy here, too, such as tramping along pole lines in the dead of winter with a 'butt in' hanging from the belt. Someone else strung us a story of how we could order some bug remover from stores for clearing bugs on a switchboard ... there were a host of tales like the "left hand jack strap", and the like.

Once we had a report of bad noise on open wire just south of Camrose. Gib asked me to go out and investigate. I needed a line man, so went to the south garage and arranged with Bert Fearey for someone to climb poles. Bert stepped over to a young Englishman new to the heavy gang and told him to go along with me. I turned and said, "I'll meet you after dinner at your place on the way out of town."

When I arrived shortly after noon, there he was, belt and spurs in hand and an enormous suitcase. I didn't think much of it until we arrived at Camrose and got a hotel room. The young guy manhandled his big piece of luggage up the stairs, opened it, and proudly displayed its contents. He had three beautiful suits, immaculately cleaned and pressed.

Apparently the gang in Calgary told him that he had been chosen for a once-in-a-lifetime trip to see Alberta, and how lucky he was. They compounded it by stating that he would see nightlife on a par with Paris and that he should go prepared.

Well, we soon headed for the 'S' pole, which was in a coulee south of town. I'd decided to isolate the line at this point, so asked my helper to don his climbing gear, scale the pole, then put two jack-straps on a certain pair of wires along with the test leads. I would then tell him when to cut the wires.

About ten minutes later when I turned and noticed that he was still sorting out his gear, I mumbled to myself, "Man! this guy is slow ..."

After another 15 minutes he still only had one

spur on. It took several more minutes to get the second one buckled in place, then his belt and tools. He shakily went over to the pole, stared up at it for the longest time, then suddenly put a bear hug around the old tamarack and started to shinny up. Every time he attempted to put a spur in, he nearly drove the gaff clean through the pole because he used such force (and this was after aiming several times). It's a good thing the pole was short!

He finally made his way to the top, but once up there couldn't let go with one hand to fasten his safety belt. In no way could I coax him to do this. As a matter of fact, I couldn't even get him back down. He was an ashen color and his knees were shaking like a rock performer. I was afraid he'd jar his gaffs loose and slither to the ground. The poor guy was now frozen to the pole as if he were part of the bark. After a long time talking calmly to him, I got him to inch his way to the ground.

I gathered up the test gear and we went to a place where the poles were stepped. The climbers assigned to us were not always the most experienced, which led us to try our own hands at climbing. It wasn't too bad if the pole was a soft one, not too high and solidly planted in the ground.

One time Bob Barham, Gib and Vaughan Monson headed out to check some open wire. As the story goes, Barham was left at one location, having assured Gib that he would be OK and that he would look after the testing there.

Gib said, "But what about connecting the test leads to the wires at the top of the pole? I'll go into town and get a lineman to help."

Barham came back, "No problem, Gib! I'll just climb like the linemen do back home in England. I'll use two loops of wire . . . I'll put one around each foot then around the pole - I'll climb up that way."

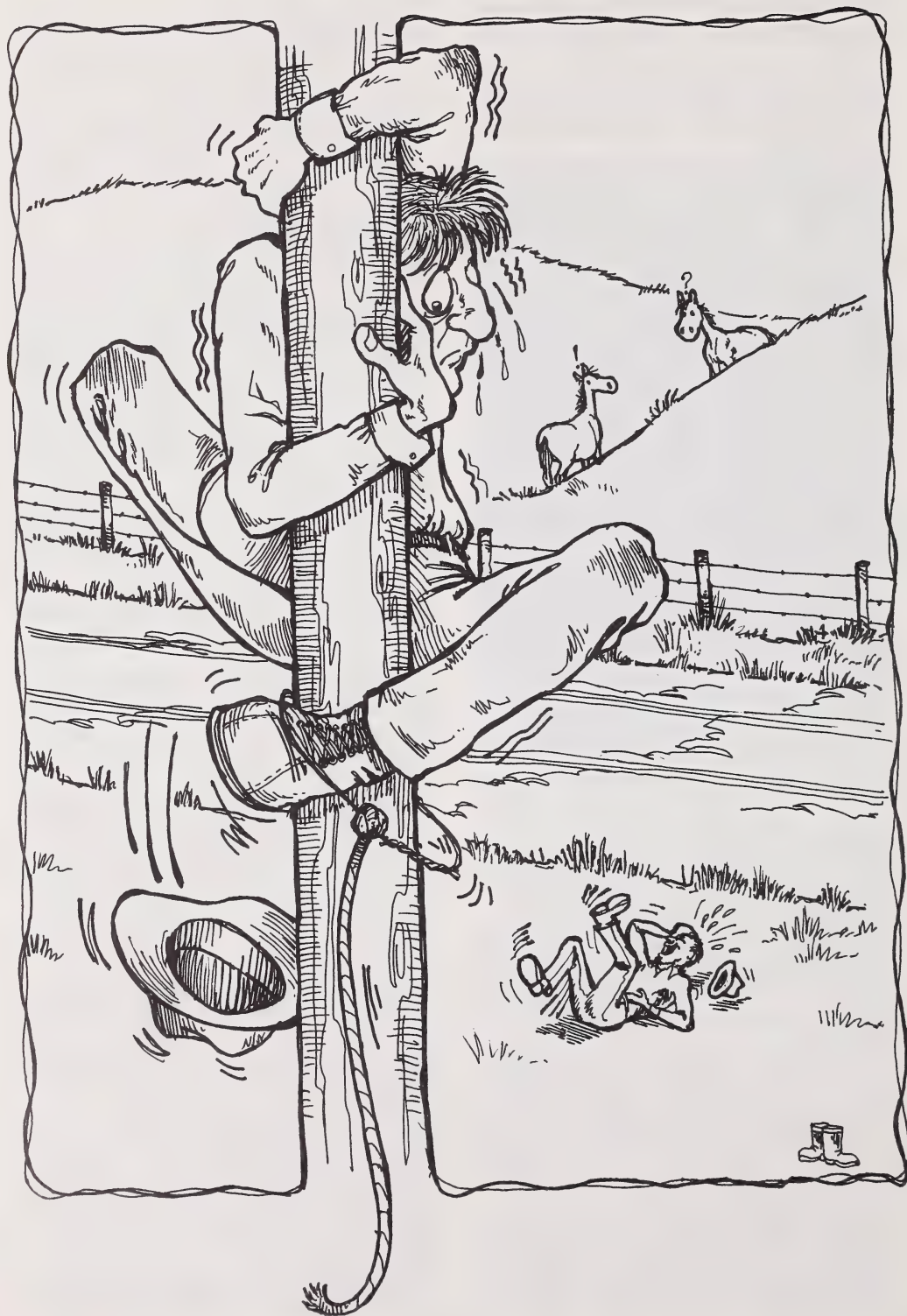
Personally, I think Bob had heard about the banana pickers in Jamaica, that they had a system like that. Anyway, Gib and Vaughan headed out, leaving Bob to look after things at his end.

It took about half an hour to drive to the far office. They set up the test and waited for Barham to call in. He was to connect a telephone set to pair one and give it a vigorous crank when ready. They waited and waited, but not a tinkle came from their bells. There was only one thing left to do: head back to where Barham was.

They rumbled along the road for some time, when all of a sudden Vaughan hollered, "Hey

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FROM
PHANTOM
TO FIBRE



Gib, Look ... there's a big black bird on that pole up ahead."

As they rolled along it soon became apparent that Barham was the big black bird. On getting closer, they saw him waving like mad — getting closer yet, they heard him hollering, "Get me down off this bl—— bird roost!". (His English accent had now disappeared).

He'd got up the pole but forgotten to take the test leads with him, then was afraid to come down by his wire loop method. He'd spent two hours clinging to the crossarms, muttering in uncomplimentary Oxford about Canadian telephone lines ... why he ever came to Canada ... that he was going to get another job — behind a desk — right away.

I'm not sure how they got him down, but if memory serves me, they lugged several bales of straw over from a nearby stack, put them at the base of the pole and told him to jump.

I've often thought about the Barham incident, and one day while out of town with Gib, asked, "Was that really the way Barham got up the pole at Camrose that time?"

"Heck no! you've got it all wrong", he replied, his face as motionless as a sphinx. "No, no! Here's how it's done ... Surely you've heard of the squirmin' worm method?"

"No, I've never heard of the squirmin' whatever ..."

Gib broke in, "Well, I know you've watched a worm squirm his way up a pole ... well! It's just like that. I showed Barham how it's done one day, when we were out making exploring wire tests at McLeod ... Here's the way."

"Take a piece of heavy wire and make it into a loop big enough to go around the pole and one of your boots." He looked around and spotted a few tie wires hanging in the van. "Here ... we can make a loop of wire right now."

He soon had the wire around a nearby pole and had one foot through the loop.

"Now see, when I put my foot down it binds ... it won't slip down the pole, I can even stand there on one foot. Mind you, I have to put a bear hug around the pole with both arms and have the other leg wrapped around too. Oh! and I forgot, you need a length of rope. Tie one end to the wire loop, pull it up tight, then clamp the free end between your teeth."

"Now, when you want to take a step higher you just hang on like hell, take the weight off the loop, and quickly snap your head back. This pulls the loop higher. Put your foot down again ... there you are ... just a-wormin' your way to the top."

By now Gib was about four feet off the ground - he'd tied a piece of lacing twine to the wire, had one end between his teeth and the other end fastened to the wire loop. Things were going pretty good — he was inching his way up the pole and getting the point across. Just then — and I'm not sure what caused it — a small whirlwind raced by — anyway, Gib sneezed and dropped the string from between his teeth. He could not now control the loop of wire around his boot.

"Hey Bob," he yelled as he clung to the pole, "Help me!"

Well, I'm not sure what I did, but I know I nearly split a gum boot from laughing. There was an awful knee-clinging, bear-hugging episode as Gib slithered to the ground — still with one foot caught up in the wire.

Finally he turned to me and with a sheepish grin hollered, "Well, Bob, that's it ... that's the 'Squirmin' Worm' way of climbing a pole — you try it!"

By now I was several strides away with no thoughts of ever falling into that trap — anyway, convulsions of hilarity had left me so weak I could hardly stand.



Calgary Transmission Eng.: Bob Barham, Steve Nicol, Doug Lawrie, Vaughan Monson (standing), "Gib" Gibbard, Lorraine Selik. (1955)

Yes, the Calgary Transmission Section would not have been the same without such guys as Bob Barham, Art Davis, Bob Taylor, Doug Lawrie, Peter Baxter, Roy Carlson, Doug Stewart, Steve Nicol, Vaughan Monson and Bob Meikle and Gib. Also, there were Vern Larsen and John Neal, as summer students in 1951.

Bob Barham, being 'truly British' and with strong feelings of English military tradition, once grew a huge, brilliant red, handlebar mustache. This was cultivated into something fantastic. Stroking, plucking and admiring through a looking glass made this lip fringe equal to that of

any Brigadier of the ancient Bengal Lancers.

Anyway, one day while eating a sandwich, a clump of the bright red foliage got caught between a couple of molars. This brought things to a grinding halt — all jaw motion ceased, accompanied by muffled mutters of curse. Immediately, Bob had offers of assistance from all sides. The popular solution was, not surprisingly, to cut the anchored strands with a pair of snips that happened to be near by.

Nothing in the world could make Bob entertain such a thought. Even if he were to remain a caught-up hair-lipped Limey for the rest of his life, he was not going to disfigure that proud red forest. After a long time of tugging the last strand was freed. Bob did not live this down for a long time. But to this day he is likely adorned, in true British tradition, with a few hairs still in permanent crinkle.

The two most active types of work at the time (as previously mentioned) were Utility Co-ordination and Transmission Improvement. Utility Co-ordination was relatively new. As it was a big important job that took us to all rural areas in the province, everyone in the section became involved with it at one time or another. The mainstays were Bob Taylor, Bob Barham, Peter Baxter and of course, Art and later, Gib.

The transmission maintenance work was largely carried out by Vaughan, Bob Meikle and myself. The work continued over a span of 10 years, (1947 to 1957) at which time the section, full fledged and experienced, was moved as a unit to Edmonton (April 1, 1957).

Some of the others in the section were:

Doug Lawrie, whom I always will remember for his contagious 'work stopping' laugh; he maintained that life was not so serious that you couldn't have at least one guffaw a day.

Vaughan was always good for a long discussion that would start one day and end three days later; a staunch supporter of Ford cars, John Deere tractors, the Noble Blade (a farm cultivator) and Saskatchewan politics.

Art Davis, a remarkable engineer who could design a power plant, a communication network, a radio broadcast station or carry out basic research on such things as the transistor. He used 'hunt and peck' on the typewriter to the tune of about 35 words per minute; he could also send the telegraph code at a blurry rate. Art's hobby was making candy. At Christmas time he'd make great mounds of all types, and we compared them most favourably to Smiles and Chuckles and Secords.

I remember travelling from Calgary to Peace River with Art. We left at 6:30 in the morning, and he didn't utter a word for the longest time as he was deep in thought. Finally he broke the silence at 3 o'clock in the afternoon.

"Hey! Let's stop for dinner", he said.

Jeep! I could hardly answer, I was so hungry. At the end of the trip he'd worked out many problems, solving all calculations in his head. When he wrote a report he'd sit down at the typewriter and start typing. He never wrote it out first. The words always fell into place with good meaning.

Gib (Campbell Gibbard) took over from Art as Assistant Transmission Engineer in 1952, because Art had left AGT to join Calgary Power — we then got our job-sheets from Gib. He guided the J carrier acceptance and carried 'Power Co-ordination' and 'Electrical Protection' into deeper study. He was a person who never seemed to know that there were only 24 hours in a day (at least he seemed to want to use every last one for work). He was a dedicated telephone engineer who worked through rain, hail or shine. Many times we'd work all day then drive home after supper, often from as far away as Lloydminster, and be back at the office early next morning. Gib's main interest away from work was playing crib, snooker and lie dice. Was he ever uncanny at the latter. I am not sure what this could have been attributed to ... even to this day he's a shrewd operator, no doubt well trained by those hundreds of games of dice.

As far as Gib's snooker was concerned, he played it entirely different. Instead of looking for the straightest cue (as most fellows do), Gib would look for the longest and crookedest one. When he started shooting, he'd sink all the red balls alternating with the black. If he won the break, as sure as anything, you'd only get a chance to shoot the golden ball.

As we travelled along a toll route, you could easily follow our trail and determine the topic of conversation from the drawings on the paper napkins in the restaurants we stopped at. We covered many subjects, but mainly theories of telephone electronics, such as echo return loss, hybrids, impedance matching, crosstalk units and the like.

On one trip to Camrose, Gib decided that it was necessary to take the trailer along for testing purposes. It was winter time; the roads were glare ice. We approached the Camrose Coulee from the south, went down the hill, then with the foot hard down to the floor, started up the

north side. About half way up the hill, we ran out of steam and the car came to a slipping, sliding halt. We sat there for several minutes, wheels spinning ...until it suddenly dawned on us that we were in a very dangerous place, as cars coming down the hill toward us would not be able to stop. We climbed out of the car in a hurry, but we could barely stand up because the road was so slippery. We finally managed to get the trailer unhitched and turned around, coaxed the car into a position to be hooked up again, then started down the hill in the direction we'd come from.

The next time we took a faster run and made it up and over the top. I hate to think of what would have happened if a vehicle had come down the hill when we were stranded in the middle of the road.

I had another experience on slippery roads with a car. Steve Nicol and I worked for several weeks on a 45A open wire Lenkurt carrier operating from Calgary to Blairmore. It was a Calgary — Vancouver system and supposed to be turned up for Christmas. We had plowed snow and worked long hours all week, but finally we had the system working.

It was the day before Christmas. We tidied up and were about to head for Calgary. A thought suddenly struck, "Why not get a Christmas tree?... there are thousands around."

I asked the fellows in the office (Roy Upham and Laddie) where the best place was to get a tree.

"Up the road there," they said, pointing to the side of Turtle Mountain.

We started up the mountain but the road was a sheet of ice. Finally we found a couple of nice trees, cut them down and threw them in the back of the station wagon. Just then we heard a distant roar. We knew we were in for trouble, as the loud noise was a giant lumber truck on its way down the mountain heading straight for us. As you can guess, when one of those 14-wheel mammoths comes down a mountain road it stops for nothing. Steve and I instantly became human cranes, our adrenaline flowed to rise to the occasion ... our strength became related to the loudness of the roar. Just as the truck came around the corner we shoved the car out of the way. The truck growled past in low, low, low gear. We looked at each other with just enough energy left to say, "Thank God for that."

I've often thought about this, and I'm now quite convinced that we had help from someone upstairs ... I now use an artificial Christmas tree.

The dB

The decibel (dB) is the universal electrical measurement for telephone work. Unlike a measurement that is made on ordinary circuits which are linear in dimension, the dB is logarithmic in nature. This is to match the response curve of hearing, which is also logarithmic. The measurement is usually made as a power reading compared to a benchmark called "0 dBm". Since the measurement can be a ratio, it can be expressed as dB above or below this reference.

The following table shows a few gains and losses of power expressed in dB:

VALUE OF dB AND POWER RATIOS FOR GAINS AND LOSSES

APPROXIMATE POWER RATIO

dB	LOSS	GAIN
1	4/5	5/4
3	1/2	2/1
6	1/4	4/1
9	1/8	8/1
10	1/10	10/1
20	1/100	100/1
30	1/1000	1000/1

$$\text{NUMBER OF dB} = 10 \log P_1/P_2$$

The average telephone set power output is approximately -10dBm sine wave measured across 900 Ohms.

*Happenings in
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*Microwave Radio —
If Marconi Could
Only Have Seen This*

AS THE crow flutters, so does the radio signal ... in a somewhat straight line from A to B. In roughly 1952, a new medium of transmission came into being. It offered competition for the old, long established pole lines, with their numerous pairs of copper wire and our memories of sleet and ice storms. This new apparatus was spawned during WW II, when ultra-high frequencies were developed and used for Radar. Little time passed before microwave radio was offered for telephone use. In this case, it was the Northern Electric microwave system, originally manufactured by Western Electric, designed by the Bell Telephone Labs in the U.S.A.

This was an exciting era, as it was to see some most unconventional new apparatus come into play: like the klystron and the light-house-tube, both vacuum tubes capable of ultra high frequency use; waveguide, a plumbers' delight; and startling new radio hardware. There were, for instance, antennas that would focus radio waves

in a beam-like fashion, allowing two antennas to eye-ball each other, operating as if connected by a thread of electrical energy.

In many cases, the antenna used a flared-out piece of waveguide at the top, called a feed-horn. It was mounted at the focal point of a large metal reflector in a way that would send the energy toward the dish. It then skittered the energy into space in a beam with almost parallel sides. The waveguide was new, in that it resembled a long piece of water pipe. The RF signal ricocheted inside along the length from wall to wall. This was so different to our early schooling which convinced us that an electrical circuit “just hadta have two wires for a goin’ and a comin’”.

Sometimes dents are purposely placed in a length of working flexible waveguide to counteract distortions that are causing bad reflections. The place where the dent is to be made is carefully located by putting pressure along the



Valleyview microwave antenna. (c. 1965)

waveguide until the location shows up on an analyser. A permanent dent is then very carefully placed with a ‘C’ clamp. This is called “dent tuning”.

Antennas took on several forms: metal discs,

parabolic-shaped reflectors, and cornucopias (sugar scoop-style dishes). All of these had to be hoisted to the top of high towers to allow a clear line-of-site path between them. This created a tremendous wind load, so special tower design and construction was required. It also created new jobs like orientation, where the antenna would be rotated on azimuth and elevation plane to allow each big electrical eye to glare exactly at its counterpart. Towers and supports had to accommodate these antennas in a way that distortions from movement would be kept to a minimum.



Periscope antenna. (c. 1968)

Converging the radio energy into a beam effectively increased the received signal to a strength which would only be possible if the radiated power had been increased to many hundreds of watts.

The real beauty of using such a high frequency radio signal (microwave) is that many voice frequency channels and TV signals can be stacked on it. The transmitted signal is in the order of 4 GHz or 4 thousand million Hz; whereas a VF channel is only 3000 Hz. A television channel

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occupies roughly 6,000,000 Hz of band width! All of these could modulate the RF carrier by way of Frequency Modulation. The original TD2 radio was capable of handling 600 VF channels ... something unheard of for that day and age. Just think — 600 channels from A to B, and now it's in the thousands!

Before dealing with other microwave oddities, let me mention a low-frequency-point-to-point radio system installed between Olds and Sundre by Stu Jones in 1947. It was the first radio system in AGT, and was shortly to be replaced by a General Electric microwave radio. The original radio operated in the 70 mHz band. It was American Army apparatus. The distant terminal was first located in the town of Sundre. However, that location did not allow sufficient signal in either direction, so it moved to a site about a mile north, on top of a very high hill.



Microwave antenna mounted on Olds watertower (G.E. system). (1955)

Art inherited the job of debugging the system after Stu left, then assigned me the job of keeping it on the air. This was the case one blizzardy afternoon. I was sitting at my desk when he motioned me over.

"Bob", he said, "I've just had a telephone call ... I want you to gather up your tools and



Bob Smith mounts Sundre 70 Mhz antenna on topped tree. (1946)

head out and fix the Olds-Sundre radio. It's packed up again!"

Soon old #44 was reluctantly snorting its way north on highway 2, the odd snow flake playing tag with the windshield wiper. After an hour or so, I reached Olds, had a coffee, then gave Bob Smith a call. He was the local telephone man.

I said, "I've come to fix the Sundre radio."

After a few minutes of testing in the Olds office, I determined the trouble was at the Sundre end — I was not receiving their signal. There was only one thing to do: head out.

Bob yelled, "Yah gotta be nuts ... wait 'till this storm quits."

I climbed in the car and yelled back, "If you don't hear from me within a couple of days, send out a St. Bernard with a keg under its neck!"

By the time Sundre was in sight, the flakes were 'sail planing' down like sheets of foolscap. I opened the gate and started plodding up the hill to the 8' x 8' radio shack. Inside it was dazzling because of a fresh coat of super white Bapco. A big light bulb hovered overhead. After a couple of hours, I found the trouble and had the transmitter sending out a signal. Gathering up my tools, I stepped out into a world of isolation. The blizzard was really whooping it up,

and the snow now about eight inches deep. Down the hill I started, slipping and slithering in high step fashion. My manoeuvres were something to behold. What with trying to ward off willows that were slapping me in the face in the pitch dark on the steep slippery hillside, I'm sure that if Arthur Murray had seen me, he would have signed me up immediately for having invented a new dance.

I ran unexpectedly into the car at the bottom, climbed in, and plowed my way back to Olds.

When I arrived, I got Bob out of bed by phone. "It's all working", I said.

He grumbled something that sounded like, "That bl---- Moore!"

Incidentally, Bob was the only line man I know who could turn around in his belt up a pole and face the end of the cross arms to work on the outer pair.

It was 6 in the morning by the time I arrived back in Calgary, the trip cemented in memory.

As I previously mentioned, this equipment was soon to be changed for a new pulse modulated microwave dual space diversity radio system made by General Electric. Its antennas were located in such a way to give space diversity, meaning that two antennas were commoned at each end but mounted physically apart. The theory was that two independent radio signals (i.e. two transmitter and two receivers) affected by any phenomena of propagation would not suffer simultaneous fading. This improved reliability considerably.

This was the type of installation at Olds and Sundre. At Olds, one antenna was mounted on each of the two legs of the water tower facing Sundre, and the installation at Sundre had one pole support for the antennas facing Olds. Bob Parkes did the initial installation; he was soon to come to AGT to work in Engineering and Plant Staff.

The radio operated in the two GHz range. I did the trouble shooting on the system for a short time after it was installed, which usually consisted only of changing out the 5Y4G rectifier tubes (they were heavily overloaded, so didn't enjoy a very long life). The radio was in turn loaded with a 34B carrier which allowed 3 voice channels. Overall operation was very good; however, one of the worst problems was the antenna system — the feeders kept breaking down. Eventually the space diversity feature was discontinued, and this modification removed one antenna from each end.

The radio was in operation for several years, and marks a star of achievement for AGT in early communication via digital microwave radio, using a space diversity feature.

It is only in this decade that further digital radio systems are again being used. The first system was installed in the spring of 1979.

One of these, operating in the 1.5 GHz band, is for subscriber use between Janvier and Chard. The other, between Red Deer and Stettler is for toll use, using two hops with operation in the 8 GHz band. Following this was the Northern Telecom system (RD3) for Trans-Canada traffic.

Getting back to the original topic, I mentioned using microwave as a new way of carrying telephone signals. In about 1950, the big talk around engineering, was a system, manufactured by Northern Electric, called a TD2 microwave radio. Preparation for this meant new design and construction methods, as huge towers were needed to support the heavy antennas. It also brought along path testing, a new technique used to locate repeaters and antenna heights. The ultra-high frequencies spewed out from microwave antennas act quite differently from ordinary radio. This radio signal is a phenomenon of ultra-high frequency and the type of antenna used. Rings of electrical polarity are formed, called Fresnel zones. The signal is also concentrated into a beam somewhat like a flashlight. Reflections, which come from the ground, weather fronts and obstacles in the path, are bothersome, as they aid or have a canceling effect. Operation in the correct Fresnel zone is therefore quite necessary to reduce fades and help maintain a constant signal at the distant end.

Aside from the constructional problems of the antenna system were others for the ancillary equipment, such as AC (Diesel) power plant for standby, plus such things as chair lifts up mountains for the maintenance staff. A good example of the latter is at Crownest Ridge in the southern part of the province. Keep in mind that this mountain ridge is high in the clouds where the wind always howls a banshee tune of warning. The lift at this location is a small basic cable car devoid of all frills, merely fulfilling the requirements for conveyance to the top of the mountain. It is used by radio maintenance personnel when the hair-pin road is blocked with snow ... nearly every month of the year.

This is my story about the lift. One day Laddie Poriz, the microwave technician, and Mac Dunn, the outside man at Blairmore, went out to work at the radio site. It was Laddy who was

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Microwave tower on top of Crowsnest Ridge. (1966)

to ride the tram to the top, under the control of Mac at the bottom, who was to operate the electric winch. Sometime after the conveyance started up the mountain, Mac began to see blue sparks shooting from the winch cable to the frame of the drum. These became more spectacular the higher the tram clawed up the precipice. Very soon, he decided something was definitely wrong. He threw the brake on the winch and went out to peer up at the tram far above.

Apparently, Laddie, at this very moment, also spotted trouble — and decided that to continue his trip would bring him ‘Nearer My God to Thee’ than he wanted. He decided to leap to safety using a rope in the tram that was there for just such emergencies. The interesting thing about this well-thought-out way of escape was that it was ‘free fall’ for the first second, then the clutch took over and slowly lowered the frantic rider to the ground.

This time, Laddie landed astraddle a small jack pine, weak-kneed and ashen colored; however, holding the record for having leapt to safety using this rickety contraption for descent.

What really happened is that, because of the strong wind through the mountain gap, the sway of the high voltage line nearby made its ground-return wire swing over far enough to touch the lift support. This made it share some of the return of snarly high voltage power. Laddie surely to this day remembers his spark punctuated ride ... not much different from the account in the ‘Good Book’ that tells of Jacob’s fiery ladder to the heavens above.

The TD2 microwave system brought a full-fledged microwave network to Canada. It was a radio system that teamed up with the ‘L’ carrier, allowing 600 channels of voice traffic handled by its baseband frequency of 60 kHz to 2.6 mHz. It could also handle a channel of television (6.0 mHz), as its IF bandwidth is ample; also transmission requirements are not as stringent for TV as for voice use. It is interesting, at this late date, to note that the TD2 radio is still functioning throughout the country, having recently undergone extensive ways-and-means to improve its performance and increase its message handling capabilities. Of note is the recent modification to the preamp stage of the IF amplifier. This incorporates a transistor in the input stage in place of the vacuum tube that was there. The old work horse (TD2) has finally succumbed to the rigors of time and has had to rely on a crutch of modern technology ... a transistor of all things!

The microwave network has now blossomed from the rugged old N.E. TD2 system using vacuum tubes with a power output of 1/2 watt in the 4 GHz band, to far advanced systems.

Some of these are the RCA 9104A, the N.E. RA1-A vacuum tube systems, and the newer solid state equipment like the N.E. Co. RA2-B, the RA3T4 and the Raytheon KTR3, using TWT output stages. These transmit up to 10 watts. The older systems used Klystrons and Lighthouse tubes, but in most cases these have been surpassed by the travelling wavetube for efficiency and output. The day will soon arrive when fully solid state equipment will take over. Mention should be made of a microwave system installed in 1964, which was entirely solid state. This is the CSM260 ITT 2 GHz radio from Boyle to Fort McMurray. It was a real ‘first’ for AGT.

The old RCA CW20 and MM600 systems also filled a gap ... each had pros and cons; a share of success and failure; some blood, sweat and tears (and curses), on the part of the acceptance man.

An amusing incident once happened on the Edmonton-Grande Prairie CW20 microwave radio system which had recently been installed. It appears that once a month a janitor visited each repeater station. He would put his box of cleaning fluids and supplies on the floor in the power room, then go about his business. On finishing the work, he’d pick up the box, lock the door and go to the next station. Almost every afternoon on the day he did his cleaning, an alarm would sound at the control center indicating the DC rectifiers had failed.

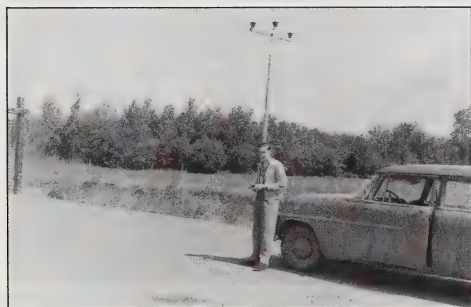
The maintenance men were really puzzled over this, and finally went out to check his cleaning procedures. All seemed to be in order.

He explained, "I just put my box down here — take out what I need and do my work, then I put things back, head out the door — locking it!"

While he was telling this, he suited his actions to his words. He bent over in the cramped space and picked everything up — but, on straightening up, his overalls caught a spring loaded switch. It momentarily snapped to the other position, and completely unaware that his little manoeuvre threw a power switch behind him, he left in complete innocence.

The boys immediately informed him that he was a janitor, not an equipment man. He took it in good humor and the problem didn't happen again.

In 1959, Steve Hrynew accompanied me on the acceptance of the Lenkurt 45BX Multiplex mated with this same radio. We had an experience on one of the trips that I will remember for a long time.



Steve Hrynew near High Prairie. (1957)

We'd loaded our test equipment and headed out. At the outskirts of the city we stopped for gas, checked the tires and so on, then proceeded north. At Whitecourt we decided to top-up with gas because the towns don't go by too often past this point, and we wanted to keep a full tank.

The service station attendant immediately brought our attention to the fact that the gas tank cap was missing.

I said, "Don't know where the old one got to, but you'd better put another one on!"

He did, and we were soon on our way again. Near High Prairie it happened — one big **BANG!** Just like standing near the muzzle of a big black powder blunderbuss that had just gone off. We came to a gravel-showering halt. We got out to examine the damage, but for the

life of us we couldn't find a thing wrong. We noticed, though, that the gas gauge read "empty".

Steve made a few mental calculations and said, "In no way Bob! We just filled 'er up back there always — we should have lots of gas."

We crawled under the car again, and to our amazement, the gas tank was as flat as a plank. It looked like a bull dozer had crawled over it.

Just then a thought was triggered ... we both blurted, "That guy who sold us the gas cap back there just gave us one without a hole in the top."

The steady drain on the tank caused such a tremendous vacuum that the tank just couldn't take it: it caved in with a bang that woke all the coyotes in the nearby forest.

We limped into a garage at High Prairie and asked if they could install a new gas tank, but found that there were none in town that would fit the car. We were in a real predicament. One of the mechanics was, however, very enterprising (and adventuresome).

He said, "Well! If it collapsed because of a vacuum, lets fill 'er up with air and blow 'er out to size again."

I didn't know what to think of this ... I had visions of gas spewing all over the place and great sheets of flames. Anyway, we were marooned and had to try something. We took the test equipment out of the car and let the service man go to it.

He drained the tank, then flushed it out with water. Then he disconnected the fuel line, and fixed up a connection from his air hose to the gas line. Then he turned the valve.

Steve and I stood back, peering around the corner of a distant building, both feet in gear ... ready for instant take-off if things turned out for the worse.

Suddenly, with a bang equal to the first one, the gas tank snapped back into place. It was amazing how closely it was restored to its original shape. The tank was tested for leaks; a tiny hole drilled in the cap and the tank filled with gas; we loaded our equipment, paid him and took off.

The trip went very well after that — except for one small problem: a rock flew up through the radiator. We lost water pretty fast and had to fill it up from the ditch every two or three miles.

When we finally reached Grande Prairie, it was about 11 o'clock at night.

The CW20 radio operated in the 2 GHz band and was capable of carrying 120 VF channels, by way of the Lenkurt 45BX multiplex. The system looked good on paper and indeed

*Microwave
Radio —
If Marconi
Could
Only Have
Seen This*

functioned quite well. There was a lot of trouble, though, with power supplies; people working on it coined many new words. It was somewhat of a breakthrough in microwave, however, as it used a klystron in the output stage.

Most microwave systems today use a travelling wave tube, further revolutionizing the output stage of microwave radio. The NE, RCA and other suppliers now offer systems that are 'completely' solid state; doing everything the TWT does at greater efficiency, they are more compact and give excellent performance. The TWT has several drawbacks: the need for high voltage power (approximately 3000 volts) which has to be rock stable. It requires much attention to make sure operating voltages do not stray off settings. The tube also has a fairly short life — and, most importantly, its cost is about \$5,000. The TWT is still hanging in there, even on the revolutionary digital systems, so the old work horse is not out to pasture yet.

Alberta had several firsts when it came to microwave radio. As already mentioned, it had the all-solid-state microwave system, called the ITT CSM260, installed between Boyle and Ft. McMurray. Included was the G.E. dual (space) diversity radio from Olds to Sundre, a digitally coded system. It is only today that engineers are turning to radio of a similar nature. We will certainly see this come to the fore-front in years to come. After that it's hard to say what will arrive.

AGT was also the first to use guyed towers and helicopter path selection using survey altimeters.

In 1960, AGT undertook quite a different approach to microwave radio. This was a tropospheric scatter system installed from Fort Smith (NWT) to Uranium City (Northern Saskatchewan).



Collins dual diversity scatter system: Calgary-Lethbridge demonstration set-up. (1956)

Let me explain: radio waves propagated into space from an antenna are affected by many things - solid or otherwise. For instance, the low, low frequencies virtually crawl along the earth's surface. As an example, the band from 6 to 60 kHz is used to carry frequencies for calibration purposes from Boulder, Colorado. This range is used because it is unaffected by ionosphere reflection and the Doppler effect associated with



Constructing Red Deer microwave tower to 312.5 ft. (1955)

these. Other frequencies say in the broadcast band of .5 to 3.0 mHz, exhibit both ground wave and reflection from the ionosphere. These are greatly affected by day or night conditions.

The so-called short waves (VHF), from 3.0 to 30 mHz, are capable of high atmospheric penetration to the layers of the ionosphere some 200 miles above the earth. These electromagnetic radio waves are therefore subject to the effects of sun spots and solar flares, thus they pick up great splashes of noise and also suffer varying degrees of reflection.

It is, however, really due to these ionized belts that radio waves are useful for world wide communication. They cannot, however, be relied upon completely because of the uncertainty of reflection. Still other frequencies (VHF) or very,

very high frequencies (waves that start upwards from 30 mHz) have great penetration features. They effectively bore right through the ionosphere, and are lost into space. Television signals of 60 to 200 mHz fall into this class.



Lethbridge cornucopia antenna being hoisted to top of tower. (1957)

Microwave frequencies of 1.0 gHz and upward fall into the UHF class, and to make them useful for communication, must be on a line of sight basis. This means that there will not be an obstacle in the path between the two antennas.

The nice part about microwave radio stems from the fact that their equivalent wave length is short enough to allow antennas that can use reflectors to focus the power and thus effect a marked gain at the receiving end. This gain can be upwards of 1000 times, and goes a long way toward making microwave radio reliable — this is also necessary, because R.F. generation is only in the order of a maximum of 10 watts of power. Keep in mind that a similar R.F. capture exists at the receiving end. This all results in a strong signal that can thus withstand the rigors of propagation.

Something interesting happened just after the TD2 system was installed at Didsbury. It was noticed that the system went into deep fades

whenever weather fronts moved across the path. This is an area that is right in the vicinity of those famous Rocky Mountain Chinooks. They were found to have considerable effect on microwave radio propagation. Bob Parkes was looking after this system, and he put a DC recorder on the



Hoar frost on fence at Granum Radio-Relay. (c. 1970)

AGC line so he could note the time the weather front would move across the path. He found that he could predict the Chinook path with a marked degree of accuracy just by watching the radio signal.

It has been found that although microwave signals tend to bore through the ionosphere, weather conditions have considerable effect on the propagation of high frequency radio signals.

It is with such phenomena in mind that scatter radio was developed. This approach offered a big saving in expense and allowed radio in remote places where building repeaters would be almost impossible. It is a method whereby a saturating radio signal is sent crashing into the troposphere some 20 to 40 kft. above the earth, with the result that some of the signal scatters down to the receive antenna approximately 100 miles away.

Such a system was the Fort Smith — Uranium City tropowave scatter radio system that was

*Microwave
Radio —
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installed in 1960 between these two places. Westinghouse equipment was used, operating in the 4.4 to 4.7 GHz range over a distance of 117 miles. It was called a "Quadruple Diversity System". A total of 10 kW of R.F. signal was transmitted, divided between 2 channels (each 5 kW). The antennas were solid dish-type reflectors, 50 feet in diameter, mounted on poles, pointed upward at a 15 degree angle.

The tremendous R.F. power was generated by huge water-cooled klystrons made by the Varian Co. Very high voltage at a corresponding high current was applied to these vacuum tubes. Vertical and horizontal signal polarization was used to further improve reliability. The equipment was installed in trailers and fed with commercial power. A 24-channel Lenkurt multiplex was connected to the radio to derive the voice frequency channels.

The system had a lot of problems and it was not too reliable. This was partly caused by Sun Noise, as it is particularly bad around 5 GHz. Remember that the antennas were pointing in a skyward direction for the wanted signal, so were also subject to solar static.

The system was a very costly one. For example, the klystrons cost \$13,000 each. It so happened that two of these instantly went up in smoke during testing when one of the cooling pumps stopped.

It had numerous safety features and a few revolutionary approaches to microwave. For instance, the transmit waveguide had arc detectors. It was reported that even during the coldest days there was no ice or frost on the transmit waveguide; however, the receive one was thickly coated.

It used equipment like parametric diodes in the mixer stages; these cost hundreds of dollars. It also used a one-part amplifier — things that at that time were really still in the research labs.

The receive signal was in the order of -60 to -100 dBm — note the range — because of the ever-changing reflection media.

Such was AGT's attempt at scatter radio. The system lasted about 15 years — it had possibilities, but never competed with conventional microwave radio.

As mentioned, microwave radio systems are vulnerable to such things as: icing, wind, lightning interference, radar interference and propagational effects from weather fronts moving across the path, not ruling out the irresponsible hunter's rifle. The generally high maintenance cost of towers and waveguides along with the rising cost of land for roads and antenna sites add to these as factors for consideration when contemplating new microwave radio routes. Microwave radio, having revolutionized communication in this era, may someday be almost unheard-of except for special application. Technology will always search out new ways and means to do the job.

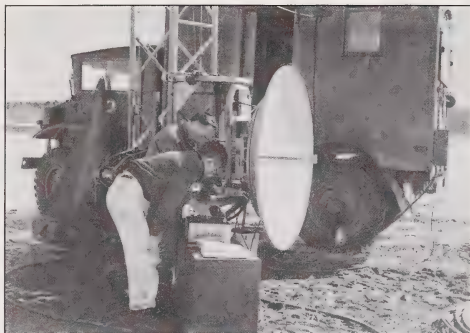
Radio Path Testing

ALTHOUGH the Engineering Maintenance section of which I was in charge was not actively involved with microwave path testing, I, however, followed the activity closely.

I was most intrigued with microwave radio, possibly because I had cut my teeth on it in the Air Force, in radar, where similar principles and hardware were used.

I will review a few of the highlights of testing the paths selected for repeater locations, and antenna heights at each place. These facts (and a few tall tales) have been gathered over the years from people like Joe Donovan, Jim MacAuley and Roy Usher.

The Microwave Radio network started in about 1953, at which time Doug Mallet-Paret and an engineer from Bell Telephones, by the name of Wally Von Hagen, surveyed the various routes, then selected the sites based on a topographical map. A couple of years later things really started to 'jell'.



Path testing Calgary-Red Deer: Roy Usher, Jim MacAuley. (1955)

Then the job was turned over to Joe Donovan, a budding young engineer, fresh from the gooey muskeg trails of the oil patch. He was to prove out the routes. Joe was assigned a crew of four men to do this work, consisting of Roy Usher, Derry Ingram, Wally McMillen and Jim MacAuley.

Two old vans fitted with antique video-link-equipment were obtained from Bell Telephones for the job. The trucks arrived by rail. They had giant balloon tires, which made them leap from side to side as they came down the ramp. There was just one small bit of uncalculated planning — the trucks were *Right Hand Drive* vehicles. They had seen European war service but were now to cart radio gear around the wilds of Canada. Before they could be taken near a



Path testing Calgary-Red Deer: Showing antenna and tower set-up. (1955)

highway, the personnel who were going to drive them needed some instruction.

It was decided that the trucks would be taken to the parking lot at the fairgrounds. The training would include backing up, parking and manoeuvres pertaining to getting stuck in muskeg. Wally McMillen told me that he was to drive the trucks from the railway station to the fairgrounds for this training. He further relates that the Edmonton traffic was bumper to bumper, and that by the time he'd arrived, he certainly didn't require any further instruction. He had become most expert at steering and changing gears on a left-hand drive vehicle, and was now able to handle it in the best 'limey' fashion.



Bill Davis and Sam Rigakis path testing. (1960)

Path testing started in the spring of 1955. Each 30 mile section south of Edmonton was to be tested. Sites were eventually located at Kavanagh, Ponoka, Red Deer, Netook, Crossfield and Kathryn. From Calgary south, routes to Medicine Hat, Lethbridge and Crowsnest followed, with sites chosen at Cheadle, Cluny, Lathom, Tilly, Bowell, Aldersyde, Parkland, and Granum, along with Pincher and Crowsnest Ridge.

McGregor Telephones were responsible for moving the towers. There were three of these, allowing them to leap-frog along so that each section could be tested with a minimum of equipment and truck movement. The towers had vertical rails attached to one side for the antenna to travel up and down on. The antenna was raised and lowered by crank, which was the



reason for the extra manpower. Each path increased the muscular physique of the cranker — by the end of the summer he was bronzed, bearded, acted a little like a robot, but had Olympian biceps that attracted every skirt in town. Cranking was not the only form of exercise. Often the antenna would blow off the track and dangle high in the air.

Wally said, "It always seemed to be my job to scale that dang tower to put it back in place." He continued, "It was all well and good in nice weather, but a lot of the testing was done in weather below zero. Joe would then have me up there freezin' my ----- off. I put up a heck of an argument, but he always got the best of me."

Once, when testing at Bowell, (the station just to the west of Medicine Hat) a bit of excitement occurred. The fellows started the gas engine to supply electricity for the equipment, then let it warm up to settle down. They then left for the night. At 8 o'clock the next morning, the worst language boiled out of the speaker at the distant end where Joe was.

Roy was on the mike shouting, "Joe! Hey Joe! If you think I'm going near that damn tower, you're mistaken."

Joe was shocked; he was really taken back by

this remark. For one thing, he'd never heard Roy swear before, and he couldn't figure out what was going on.

He came back, "What the heck d'ya mean! . . . Fire her up and send me a signal."

"Nothing doin'!" yelled Roy, "I'm not going near that rattler for anything. It's five feet long and as big as my arm . . . he's all coiled up around the winch handle, and if you want to move that darn crank you better come down and do it yourself."

Joe blurted, "Snake! . . . you mean you got a real live rattler?"

"Rattler!", exploded Roy, "It's as big as a Python an' his tongue is goin' in and out like a sewing machine needle."

Now Joe just happened to have the traits of an old snake charmer. As a matter of fact, in his past he was a charmer of many things.

He came back, "Tell ya what ... take a shovel and hold it at arm's length, then wave it back and forth in front of its eyes. When you get him mesmerized, make a quick pass at him with the shovel and lay him out cold."

Jim MacAuley was now all excited. He was all for getting the rattle off the snake's tail. The snake was snapping and crackling like a 'shorted'

high voltage power line. Jim grabbed the shovel and started moving the point back and forth in front of the snake. It soon uncoiled, extended its head and started a rhythmic sway, its head following the shovel from side to side ... beady eyes zeroed in on Jim ... its forked tongue snapped a tattoo-like rhythm, instantly ready to spit venom. All of a sudden, Jim saw an opening and took a swipe at the snake. In doing, so he stumbled and went down on his knees in the grass. His retreat was instant — he was certain the grass harboured a thousand rattlers. He looked for the snake, but it had slithered to the ground and was wriggling at a fast pace through the grass heading for places unknown, more afraid than Jim. Jim, still determined, dressed in high cowboy boots and a pair of cut-off ragged jeans, bolted after it.

Roy said it was a sight he'll never forget. There was MacAuley hopping from one side to the other, taking lethal swipes at the rattler — the snake all the time warning him with a crescendoing rattle of its alarm equipment. Off across the sage brush they went — Jim like a roadrunner on hot stones. Finally back he came with a set of rattles, a souvenir of days of path testing at the Howell microwave site.

He said, "They claimed there might be some snakes down there but be darned if I thought they'd try helpin' out with the path testing."

Joe, Roy, Jim, Derry and Wally, although the going was rough at times, surely deserve a round of applause for their pioneering effort in bringing microwave radio to AGT. Each of them have their own stories to tell about the job.

There was the time they picked their way up a sheer cliff of a mountain in the Crowsnest pass to select a site, then found on arriving at the top that a good road came up the other side; or when the tower nearly toppled over on top of Crowsnest Ridge; and they all chimed in as to what a job it was, sweeping up the big pile of wooden matches Donovan always left on the floor of the van (from trying to keep his big pipes turning out a curl of blue smoke). They surely look back to those days with the feeling of a job well done. Joe especially deserves credit for his part in developing path testing methods, and for setting the stage for the reliable approach we now use for proving-out microwave paths.

The tower site at Calgary was to be on top of the toll building at 7th Avenue S.W. The test tower for this route was therefore set up on the old telephone building nearby. There used to be a plaque imbedded in the sidewalk in front

of this building with the words "Bell Telephone Co." Those were in the days of 'open wire' and 'step' equipment. AGT was to see microwave radio some 30 years later. The test tower was roughly 260 feet high and mounted on the roof. Several streets were closed off, then the trolley depowered, to permit threading the guys to various anchor points below.

Microwave radio was turned up for service in 1956, bringing TV in time for the Grey Cup of that year. Following that, AGT decided to get into microwave testing in a big way. New vehicles were purchased, along with 3 three-hundred-foot towers and new microwave test gear. Charlie Littlewood was given the job of designing and assembling this. Soon microwave testing was pushed to the far corners of the province with greater efficiency and accuracy. A hop between Toronto and Buffalo, New York (deep in Bell hinterland) was also proven out, then numerous checks were made in neighboring provinces.

The setup now employed electric power winches to raise and lower the antennas, and they could also be turned sideways by electrical control. R.F. power calibration could be done from the ground, unlike the old way, where you had to take a meter to the top of the tower. The electric winches were a welcome refinement to the original 'armstrong' method with people like Derry, Wally and Jim furnishing the head of steam.

The microwave signals radiating from a parabolic reflector arrange themselves into polarized strata of electromagnetic energy called Fresnel zones. It is the object of Path Testing to determine the heights and extremes of these zones in order to select a suitable height for the final antenna. A reliable microwave signal must have good clearance above the earth and be well centered in a particular Fresnel zone. These are line-of-sight paths, meaning that a straight line could be drawn between the 2 antennas without any obstacle interrupting the path. This is usually a distance of about 30 miles.

It was with this task in mind that Joe and his crew, then later Charlie, set out to prove out microwave routes. The first equipment, as mentioned, belonged to Bell Telephones. Charlie redesigned the whole system, then with people like Hugh Kroetch, built a new and more efficient path testing arrangement.

Several years later Bill Davis (Art Davis's son) once more redesigned it, automating it to a large degree. He employed a U.H.F. radio link to

bring the distant 'antenna information' back (from the transmitting end) then, together with the local received signal, applied it to an 'XY' plotter. This device traced a line across a page of graph paper in relation to the strength of the received signal over the band of frequencies of interest for that particular antenna height. This relieved much of the drudgery of the slow point-by-point method of plotting the readings.

The microwave bands are located in what is called the 2, 4, 6, 8, GHz ranges. Let's stop for an interesting comparison of the length of an antenna for these signals, and one for a frequency used by an ordinary living room radio for stations like CFRN. CFRN on 1260 kHz requires an antenna 225 feet long. An antenna for the microwave frequency of, say, 6 GHz is 5 cm or 2 inches — so small it can be mounted in the focal point of a parabolic shaped reflector. This concentrates the radio signal into a beam with about 3 degrees of spread. It sends most of the radio energy to the far end to effectively increase the antenna gain to an approximate figure of 1000. The tiny signal transmitted by the microwave equipment therefore becomes quite sufficient to give reliable communication, especially since there is an equivalent antenna gain at the receiving end.

I was discussing 'radio path testing' with Hugh Kroetch one day. He related the various techniques, as used with the modern vans and equally modern equipment. However, one technique was pretty basic, effective and amusing.

Apparently, after studying the topographical maps, a helicopter 'fly over' of the selected site was made. He said that then by hovering the whirlybird over a big Jack Pine near the site, with the aid of the down draft from the big spinning vanes, he could wind vivid pink or blue toilet paper around the old tree in the fanciest Xmas Tree decoration you ever saw.

Radio path testing took the gang to spots likely never set foot on by white man: where hunting and fishing were the best in the world, and, better still, there was the magnificent Alberta scenery, making a mental photo that will last forever.

In a way, these people deserve mention in the scrolls of Alberta Telephone fame, as they did much to pioneer communication network to the extremes of our communities, proving a life-line for the scattered settlements to come.

I feel I had part in this exciting endeavor, as I was in charge of the Engineering Laboratory,

and played a small part in having special test equipment constructed and serviced for the tests necessary in determining antenna location and height, which was the purpose of radio path testing.

Some of the people actively engaged in this work were:

Al Jones	Chuck Barry
Charlie Littlewood	Hugh Kroetsch
Bill Davis	Eric Minogue.

As a finale, here is the list of the people who formed the original Radio Equipment Design Section of 1955:

Doug Mallet-Paret, Supervisor

Joe Donovan	Roy Usher
Bob Parkes	Arnold Lyngberg
John Borseth	Nick Davids
Charlie Littlewood	Steve Kovacs
Bill Inkman	Wolf Plath

I am including another name: Bill Good. Although he was not part of the radio section, he was close to the activity in many ways. A tower man, Bill is a very likeable person, keen on helping people in every way. His name is now legend wherever radio towers are the question. He carried out tower work for many years, building all types for special applications, and has devised original designs and construction techniques.

I must mention something about metropolitan junctions, which became necessary at Calgary and Edmonton. These are centering points that 'hub' the various microwave radio routes around the two cities (actually, this is jumping ahead several years, but indicative of what was to come, and does tie in to a degree).

The growth of the cities, with the trend to high-rise buildings of one sort or another, soon made it apparent that microwave paths would be interfered with. It was not so much the actual blockage of signal, but the effects of reflections off large structures. The signal sort of banked its way to and fro, like a badly-shot cue ball bouncing off the cushions of a billiard table. The reflected signal thus often arrived at the receive antenna in varying degrees of time. This interfered with the direct radio signal, causing undesirable effects on television and digital transmission. Plans were quickly on the drawing board to change the routing to reduce this effect.

It was decided to construct several microwave collection points around the major cities, then to bring the signal into the toll offices by underground coaxial cable. Three places were



Edmonton Head Office – the “Green Building” on 107th Street. (c. 1953)

selected for the outskirts of Calgary and three for Edmonton. The Calgary sites were Crossfield, Cheadle and Aldersyde. Edmonton's were Kavanagh and Chipman. Sherwood Park is now a major centering point for microwave radio.

Establishing these places allowed the microwave routes to break out terminating channels, yet permitted through channels to continue on. The appropriate channels were stripped off and extended to the downtown toll offices, where toll switching machines would route them further. The link between toll office and the metro junction was a very expensive, multitube underground coaxial cable. A heavy route multiplex system operating over the coaxial cable actually carried the signal. It was called a 'wire line entrance link'.

An interesting microwave 'first' in Canada came about because of radio signal blockage before the junctions were actually built. It happened in Calgary. A reflector was installed so it would bounce the radio signal around a large building that was blocking its path. This reflector was nothing more than a flat metal-faced wooden structure placed on top of a building at an angle that would ricochet the signal over to the antenna. The path happened to be from

Aldersyde to the 7th Avenue toll building where the antenna was located. The reflector was often referred to as the bill-board. It was used until the underground coaxial wire line entrance link was completed from Aldersyde to the toll building. The radio signal would then terminate at Aldersyde.

I rather suspect the whole idea came from some radio path design engineer who followed a lucrative pastime as a snooker shark.

These microwave junctions were to become massive tower installations with an assortment of dishes (antennas) peering down each microwave route.

Although it happened prior to my time with the company, I would like to include the following account.

In early 1946, Don Edwards, Bill Mason, Russ Crawford, Scotty Horn and Sid Fisher were to test a radio path. It was for radio equipment operating in the 70 MHz band, from Luscar, a small coal mining town south of Edson, to the top of a mountain near Jasper, called Signal Mountain.

Luscar was already connected to the telephone network, and so was a suitable jumping-off point for radio to continue the circuit over the mountains to the Jasper area. If the plan worked, it



Start of the 7th Ave. Toll Bldg. in Calgary. (1956)

would have been quite a cost saving, and a first for AGT. The radio equipment and other apparatus was taken up the trail by car, though some was carried up by hand. It was back-breaking work, as the trail was covered with brush, and several bridges had to be built so fast-flowing streams could be crossed. The odd tree in the middle of the trail had to be cut, so the equipment could get through.

Russ worked hard at this, but kept his eyes peeled for any large black object that might be slinking around.

The large 6-foot, three-element Yagi antenna had to be mounted on a tall jack pine. This job was undertaken by Don Edwards and Scotty. After the equipment was set up and powered, listening and calling began at scheduled times. Eventually, a trip was made by car to the far end to check things out. All seemed to be in order, so more calling and listening was done.

Eventually the test was abandoned, as no signal could be heard. Although the test failed, the effort must go down in AGT history as a valiant attempt to use radio to extend a communication link, carried out by AGT pioneers.

When I think about the episode, I relate it to Marconi's tests to send a signal across the Atlantic. He too was located in a flapping tent on the

windswept moors at Puldu, Cornwall, on December 12, 1901. He too had a Signal Hill.

This first radio path test carried out by AGT has today become the modern way to check the signal path for tower and antenna placement.



Start of the Alberta Telephone Tower in Edmonton. (1969)

Equipment Eras

TELEPHONE equipment in AGT falls into the approximate time frames as listed below:

The magneto telephone set 1906 - 1962.

DC Telegraph 1906 - 1924.

The B, G and H open wire carrier;

B (The B was first in British Empire): 1921 to 1945 G: 1929 to 1948 H: 1935 to 1960

The 40C1 carrier telegraph from 1930 to 1960.

C carrier 1921 to 1962 43A1 VF Telegraph 1957 to 1965.

The J carrier from 1951 to 1962.

The 70 MHz Fisher Army radio from 1946 to 1953.

The G.E. Pulse Modulated microwave system Olds/Sundre (Dual space diversity) from 1953 to 1968.

The TD2 microwave system (high frequency triode output — lighthouse tube) and L carrier from 1957 to still in use

(upgrade to include transistor in 1st IF preamplifier stage for improved noise

performance). Further modified in 1970's.
I.T.T. CSM260 solid state microwave radio from
1963 to 1978. Now used for order wire and
alarms, Boyle - Fort McMurray.

Other microwave systems (T.W.T.) output):

CW 20 RCA - 1957-1961
MM600 RCA - 1960-present
RA1-A N.E. - 1960-present
9104 RCA - 1969-present
RA2B N.E. - 1969-present
CTR108 Lenkurt - 1969-present
Lenkurt 74A - 1960-present
MR10/20 Motorola - 1959-present
Lenkurt 75A - 1964-present
Raytheon KTR3 - 1973-present
Lenkurt 878F & C - 1972-present

Westinghouse 5 GHz Troposcatter Radio
System. 1960-1965

Philips W.L.E.L. from 1969-present.

Step by Step Switching from 1906-present

AGT (Edmonton) had first step office in North
America.

Magneto PBX's 1920 - 1962.

Cordless boards from 1958 - 1977.

#5 XBAR Local Switching from 1961-present

XBAR Tandem from 1961 - 1979.

Siemens Auto Toll Switching machines from
1948 - 1979. Used the tail eating switching
principle (self balancing).

4A N.E. Toll Switch from 1971-present.

SA1 Local Switching from 1958-present.

SF1 from 1963-present.

SP1 from 1970-present.

C1EAX from 1976-present

#1EAX from 1977-present

#2EAX from 1977-present

#3EAX - 1979-present.

DMS 10 from 1979-present

DMS 100 from 1979-present

Toll Centering from 1963-present.

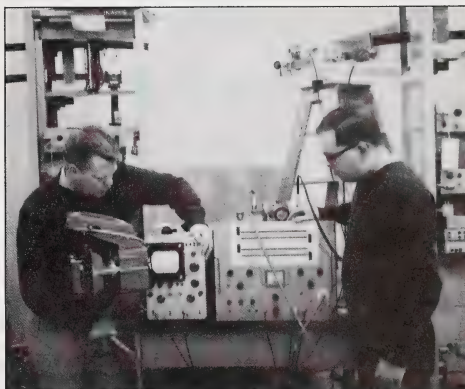
Buried Cable rural program from 1965 (program
finished 1973) - present.

PCM from 1973 to present. VF and Carrier
loading and balancing from (approx) 1939 to
present.

RD3 N. Tel. Co. Digital Radio & Farinon
Digital Radio, 1979 - . Fiber Optics 1980 - .

There is a great deal of other equipment that
should be listed. I have not, for instance, men-
tioned power. This is an area that has seen
radical change, going from the massive, noisy,
old machines to gaudy colored panels housing
automatic equipment with the utmost of elec-
trical sophistication; printed circuit boards
with IC's, SCR's, transistors, uni-junctions,
toroids, thermistors, zeners and other tiny com-
ponents, all with a high degree of education mar-
shalled to keep voltage, current and power, in
line.

Equipment
Eras



Wes Durnall and John Wade testing. (1971)



Walter Kachorowski getting his hands into CATV
equipment. (1971)

These are parts that only radio engineers had
license to use, but now technology marches them
in and assigns them duties in the power room.
Battery regulation must be maintained to
decimal tolerance for such things as electronic
switching machines. Electrical noise must be
reduced to an absolute minimum and switching



Dennis Brooks, Jim Rich on Acceptance job. (1971)

transients just dare not occur. Their profile is too close to that of the digital pulses of the computer and the PCM bit stream.

Recently, several new technologies have paved a smooth path to more exotic and sophisticated communication. One is Digital Radio and the



Ed Svekla and PCM Carrier equipment. (c. 1975)

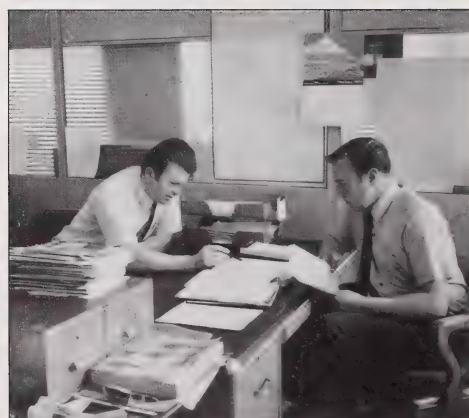


Move from the CN Tower to the Alberta Telephone Tower: Ted Thomas, Al Pratt. (1971)



Peter Schmidt, John Wade, Gary Platt in the CN Tower. (1971)

other, which incidentally has set the electronic world agog, is Optical Beam Guidance or, as it is more commonly called, 'Fiber Optics'. This is the transmission of a beam of light down a thin strand of glass. It carries the communication signal as did copper wire. The efficiencies and new uses such a system offers can be likened not to just a can of worms — no, it's more like opening a can of rampant rattlesnakes. This will indeed make high quality videophone possible, so that people can view each other as they talk. Surveillance and monitoring processes also becomes possible, as does a complex, "wired city" concept of utility control — not to mention other uses we dare not even dream of yet.



Gary Platt and Bill Kamuchik discussing transmission problems. (1971)

On April 14, 1978, Mr. Jack Childs — Director of AGT — made a radio news announcement that AGT was going ahead with a Fiber Optics field trial between Cheadle and Calgary.

The signal transmitted down the 'light guide'



Transmission Staff in CN Tower: Tammy Yestal, Judy, Bill Watson, Gary Platt, (Angie Giacobbo behind), Peter Schmidt, Irene, and Shirley Massel. (1971)

is in the form of pulses, created at one end by revolutionary new laser beam of light. The signals are then re-created by equally revolutionary avalanche photo transistors.



Neal Robertson in CN Tower office. (1971)

Our ways have changed ... instead of technicians in smocks with tool belts snugged around their waists, there soon will be machines and apparatus that troubleshoot themselves and indicate by print and alarm where breakdown exists — modern equipment working in clinically

clean rooms of rainbow eye appeals, and repair means merely replacing printed circuit modules containing a myriad of miniature components.

In summary, we will soon see advanced telephone sets that stutter out signal pulses which in turn change the family of signals into a concerto of baritone or soprano, or gurgle of voice tones.

God will still see to it that voice chords vibrate and ears listen. Analogue will never die.



Camrose: Jim Cobb, Grant Reed, Gavin Miller, Glen Fossen. (c. 1956).

The People of the Network

IN THIS section, I wish to mention people throughout the province with whom we dealt as a field force.

I will mention names. Now, I know that this is not good practice, as I am bound to miss someone, and to that person I offer my deep apologies, with the hope that he will understand our appreciation of our work association.

When our section was formed in 1948 it was, as previously mentioned, given the responsibility of improving the transmission of various signals carried by the telephone network. This, of course, was the name of the game, as our boss, Russ Crawford, was the Transmission Engineer.

Russ was a pleasure to work for — a most considerate person who always listened to what we had to say, was always concerned about our well being, and had a special brand of wit that could not be matched.

Russ used to comment: “Always listen to what the other guy has to say. He may not know much about the topic but he might just change your

view and get you thinking along the right way.” He used to cap this with, “Remember! God gave you two ears and one tongue. This means that He wants you to do twice as much listening as talking.”

Our main contact was with people in the Plant Department. We travelled from town to town meeting and working with many of them, “Old Timers” and all. Their experience and dedication just had to rub off on us. We grew up making friends wherever we went. We developed trust that made the most experienced person go out of his way to help us. We shared many an hour of good old fashioned shop-talk, spliced to a long tale of how service was restored in “them-thar’days”, under most adverse conditions. Some of these tales made the classic snow shoe episode seem like a picnic.

We developed a bond of friendship that swelled our pride, and we had the feeling that AGT was our company and that we would do as much as we could to make it successful. We took books, prints and manuals home to read; we worked many unpaid hours, just driving home from a job or possibly fixing an ‘Onan’ power plant that had sputtered to an ornery stop earlier that day. We travelled all types of weather. I think “old 44” felt that chains were permanent attire on its wheels. Pavement was out of the question . . . gravel and mud the way of the day. Here are some of the people whom I am sure Gib, Vaughan Monson, Bob Taylor, Bob Meikle, myself and others of the section include as special friends; people who helped us so much in doing our part of keeping the network oiled and whirring.

Mr. W. Jamieson Sr. — Calgary:

Mr. Jamieson came to me at the time of his retirement and gave me many treasured old books, notes and information he’d collected over the years.

He said, “Bob, take these. If they’re any good, keep them; if not, throw them away.” He continued, “I know you’ll go on to see a telephone network of breathtaking advancement.” This I have! He was a dedicated telephone man always willing to help his workers. A bit of a loud talker who made many a young apprentice shrink down in his boots — but he had a heart of gold.

Mr. Frank Watkins — Lethbridge (Wire Chief):

Frank likely had the greatest effect on us of

anyone. I am sure we will never forget the many times he put his hand on our shoulders and explained how a filter should be wired, or the “1 plus 4” carrier should be adjusted, or a J carrier should operate, and so on. He always did this in a way that made you feel that *you* had thought up the idea. A tireless worker, most dedicated to his job — a real support and friend of our section.

Mr. Jack Mulligan — Calgary:

A pipe smoking, dapper character who was always dropping in on us to say hello, often to explain a problem (or tell of the time the raven stole his golf ball). I personally owe much to him for his time and efforts in teaching me the operation of carriers, test boards and the like. This got me all excited about telephone and really changed my course in life’s endeavors. Jack was an avid fisherman — the only man I’ve heard of who caught one of those famous Kananaskis rainbow trout on a radish. Jack will always be remembered by our gang as a real friend.

Mr. Sandy Smith — Three Hills, Red Deer, Calgary:

To me, Sandy will always be of special remembrance because he helped me get a start when I was groping for something that not quite within my grasp: a knowledge of radio and electronics. Sandy dropped into our offices in the Calgary Toll building very often — work always stopped as he would relate an old yarn or a damn good joke. A person we will always remember.

Mr. Ralph Losie — Installation Superintendent and later General Manager:

A real gentleman always willing to help out. He got the report for me on how subcycle ringers work ... well! I covered that little episode elsewhere.

Mr. Gerald Dickie — Calgary:

A person most respected by our group, but always having extra good yarns that stopped us cold. I am sure Gib remembers some of ones I won’t go into here. They often made us fall off our chairs in a fit of hilarity, especially as he often expounded them in a loud voice in the coffee shop.

In 1956 Mr. Dickie called me into his office. He said, "Bob, I've got a good job for you — the Banff office has an opening for a foreman and I think you should have a look at it — it's yours if you wish!"

This precipitated a trip to Banff by my wife and myself. I looked over the office, the telephone network and the housing situation, then did some serious head scratching. What a wonderful setting, and all those great fishing streams. I'm not sure what persuaded me, but I passed up the chance to live in Banff for the rest of my life, doing telephone work in the world's most scenic spot. It's a decision I have regretted for many years. I would have had some real fish stories to add to my collection if I'd taken him up.

Mr. Gerry Byrne — Wire Chief, Calgary:

Anytime I burned out a thermocouple it always seemed to be one of Jerry's. I'd then receive a personal confrontation regarding the act — I'd stand at rigid attention with knees rattling like a tin plate that had dropped to the floor and was slowly wobbling to a halt. He always had time, though, to stop and chat, and many problems were solved just leaning against one of the lab benches in the back room.

Other names are as follows:

Mr. Harold Johnson — Lineman, Calgary West
Mr. Jim Fretwell — Calgary Lineman (Glider Pilot)

Mr. Wilf Woods — Installation Superintendent
Mr. Cliff Johnson — District — Calgary West (Foreman)

Mr. Alf Baird — Repair Shop Foreman
Mr. Fraser Wilson — Calgary Main Switching Foreman

Mr. Joe Chamberlain — Southwest Exchange
Mr. Wye Armstrong — Calgary City Heavy Gang Foreman

Mr. Bill Hewson — Calgary CO Foreman
Mr. Topley — Calgary Main Switchman
Mr. Bill Mallen — Outside Plant Engineering
Mr. Jack Childs — Company Director
Mr. Bill Powell — System Acceptance & Maintenance, Edmonton (my boss)

Mr. Al Pratt — System Acceptance, Edmonton (my boss)

Mr. Joe Donovan — Systems Acceptance, Edmonton (my boss)

Mr. Bill Russ — O.P. Foreman, Calgary
Mr. Bill Cordingley — Cable Splicing Foreman, Calgary

Mr. George Good — Jasper Place Exchange

Mr. Bob Hardy — Garage Mechanic, Calgary
Mr. Roy Green Sr. — Vegreville District
Mr. Ernie Flynn — Peace River
Mr. Tommy Goodsir — Vegreville
Mr. Bert Collins — Edmonton Wire Chief
Mr. Les Smith — Grande Prairie
Mr. Fred Daniels — Edmonton Wire Chief
Mr. Ole Gardner — Calgary Hill Exchange
Mr. Bob Michon — Hinton District
Mr. Jim Marr — Calgary Louise Exchange
Mr. Doug Thompson — Calgary East Exchange
Mr. Tony Runnels — Brooks
Mr. Reg Skitch — Lloydminster District
Mr. Jim Cobb — Camrose Toll Office
Mr. Jack Reid — Vermilion District
Mr. Don Robertson — Claresholm District
Mr. Bill Muter — Red Deer Toll Office
Mr. Bill Scott — Red Deer
Mr. Len Elder Sr. — Vegreville.

Mr. Jim Barnes must also be included — I worked for him when he was Chief Engineer. I marvelled at his casual, yet effective way of getting work done. I thoroughly enjoyed my short association with him.

Mr. Chip McDonough
Mr. Wally Scott — Edmonton
Mr. Harold Mackie.

I think I could write an anecdote about each of these people as our work brought us in close contact with them.

So ... a few names who were our everyday acquaintances. I trust that I have not offended through omission anyone who assisted or guided our transmission work on the telephone trails, as many old timers certainly did.

Further ... throughout the years of carrying out a Supervisor's role in the Engineering Department, I have enjoyed a marked degree of satisfaction from the results obtained. This, I owe to the people working for me — it has certainly been through their efforts that the success of each endeavor has been achieved. I owe a vote of appreciation to these people — most of the names are listed below:

Don Hunt — P.Eng
Jim McDonald — P.Eng
George Bidulock — P.Eng
Avtar Dhaliwal — P.Eng
John Bourak — P.Eng
Lorne Baker — P.Eng
Bob McLean — P.Eng
Bob Sutcliffe — P.Eng
Ron Kalvaitis — P.Eng
Gordon Martin
Neal Robertson

Jim Rich — P.Eng
 Case Muilwyk — P.Eng
 John Wade
 Ewald Roesler — P.Eng
 Walter Kachorowski — P.Eng
 John Jamieson — P.Eng
 Lee Speer — P.Eng
 Bill Gerritsen — P.Eng
 Tuk Yamamoto — P.Eng
 Gary Platt
 Andy Coyle
 John O'Neill
 Jim Sandham — P.Eng
 Eliot Graham
 Peter Schmidt
 Bob Walker
 Bob Huang — P.Eng
 Laurence Lo — P.Eng
 Jim Nikiforuk — P.Eng
 Ed Svekla
 Stan Elchuk
 Louis Mester — P.Eng
 John Strobel
 Ed Doepel
 Reg Minty
 John Figgures — P.Eng
 Tony Braun — P.Eng
 Wes Dutnall
 Jack Kirk
 Reg Coroy
 Ray Post — P.Eng
 Rawleigh Brunelle
 Case Plas
 Fred Skovberg — P.Eng
 Martin Berger
 Heinz Frank — P.Eng
 Jim Belcourt
 Wally Phinney
 Del Kryvenchuk — P.Eng
 Mel Kohut
 Lee Ettinger — P.Eng
 Dave Saul — P.Eng
 Dave Thomson ("Dry Thomson — no Pee")
 — P.Eng
 Bill Kamuchik
 Hilton Sinclair — P.Eng
 Al Shelton — P.Eng
 Rod McNeil — P.Eng
 Bob O'Brien — P.Eng
 Fred Linton
 Matt Romanow — P.Eng
 Rod McPherson
 Lou Frontain
 Bill Watson
 Brian Boyden
 Stamatiou Vlachos — P.Eng



Lloydminster: Bob Turnbull, Bill Skitch. (1960)



Transmission office (L-R): Lorne Baker, Roy Young, Vaughan Monson, Don Shand, Harry Mandryk. (1958)



Outside Plant Engineering, 5th Floor 'Green, or Glass House': FRONT ROW: Johnny Popovich; 2nd ROW: Robbie Stronach, Scott Kennedy, Glen Strong; 3rd ROW: Bob Grant, Bill Baas, Bill Dancocks. (c. 1955)



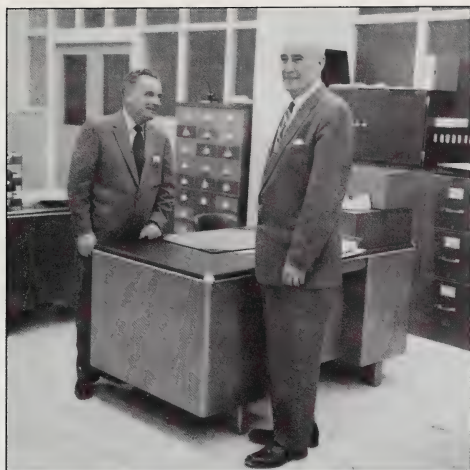
Red Deer: Evan Addy, Harold Cooper, Ray Simonson. (1962)



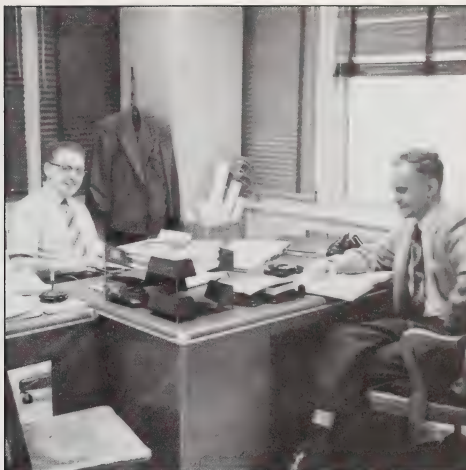
Red Deer: Harry Parker, Bill Malen, Ralph Losie, Don Edwards. (1961)



Lethbridge: Walter Inglis. (1957)



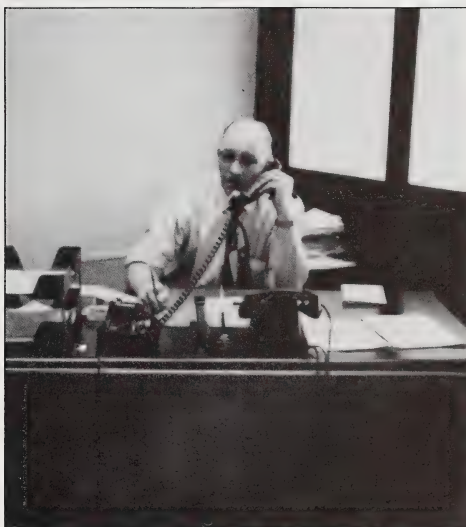
Lethbridge: Frank Watkins, Harry Parker. (1958)



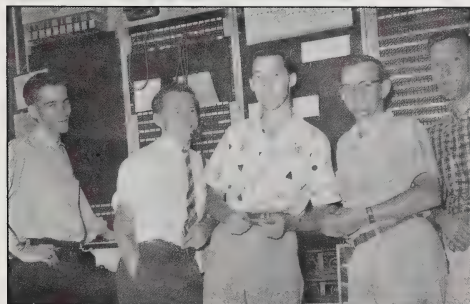
Edmonton: Lee Harrison, "Gib" Gibbard. (1958)



Lethbridge: Jack Brown (rear), Bruce McKenzie. (1957)



Calgary: Howard Nicholson. (1953)



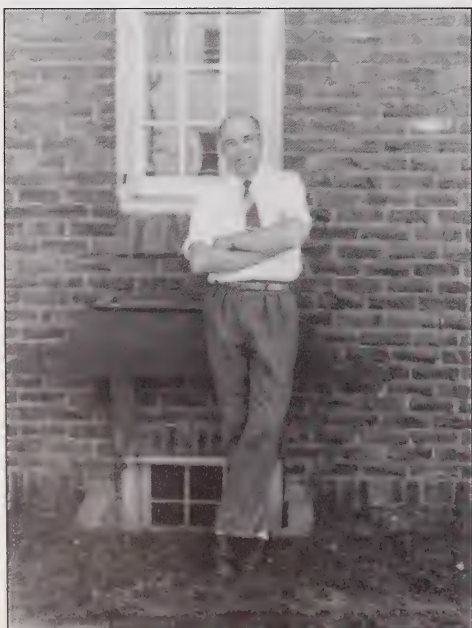
Lethbridge: Delmer Homulus, Bruce McKenzie, Jack Brown, Dick Metcalf, Gordon Innes. (1957)



Calgary: Gerald Dickie. (1955)



Edmonton, Bob Reid, Don Baillie. (1953)



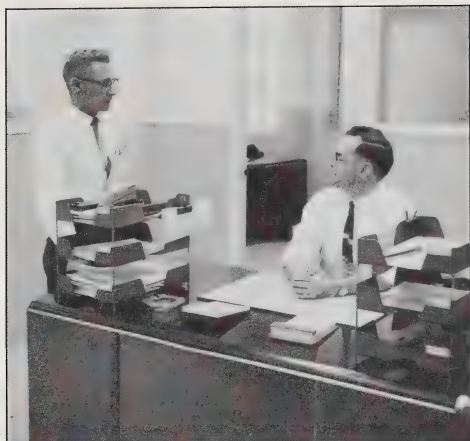
Grande Prairie: Les Smith (1959)



Red Deer: Bill Muter, Bill Scott. (1960)



Lethbridge: Howie Hill. (1953)



Lethbridge: Jack Switzer, Norm Clark. (1957)



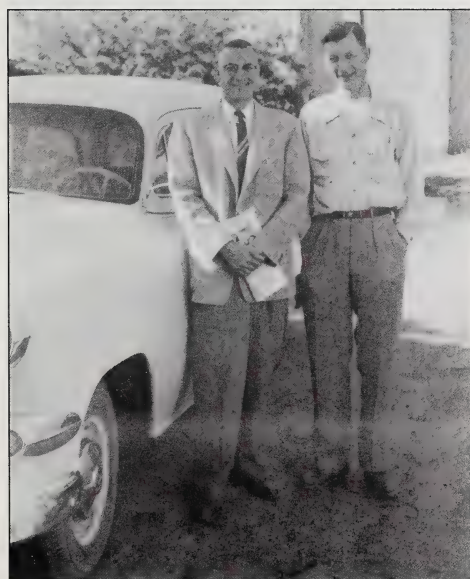
Sangudo: Terry O'Laughlin. (1964)



Calgary: Tommy Campbell. (1956)



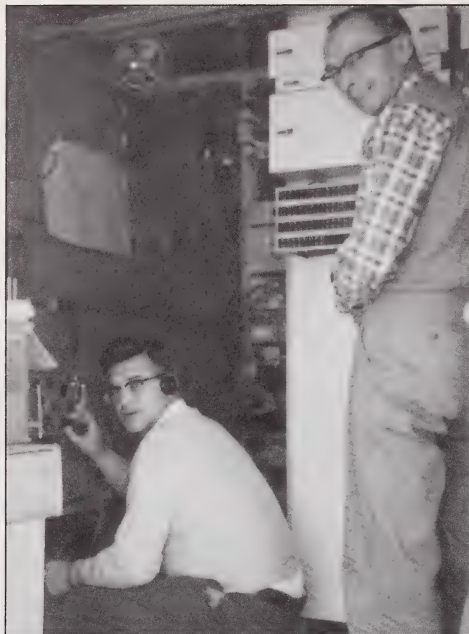
Calgary: Bill Hewson, Fraser Wilson. (1956)



Wetaskiwin: Ted Baker, Bob Smith. (1956)



Whitecourt: Dave Saganiuk, Peter Thede, Steve Nicol. (1965)



Whitecourt Radio: Nick Davids, Al Emeny. (1965)



MA-4 repeater cabinet Edmonton-Jasper System: Walter Konhauser. (1966)



George Bidulock at Dunvegan Ferry Crossing on the Peace River. (1962)



Sangudo Radio Site: Ed Murphy, Ray Armstrong. (1964)



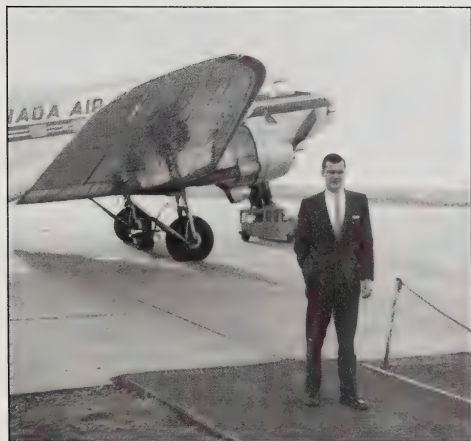
Transmission office: Jack Kirk, Martin Berger, Al Shelton, Bill Baas. (1958)



Vegreville: Don Green, Harry Allen, Cam Campbell. (1961)



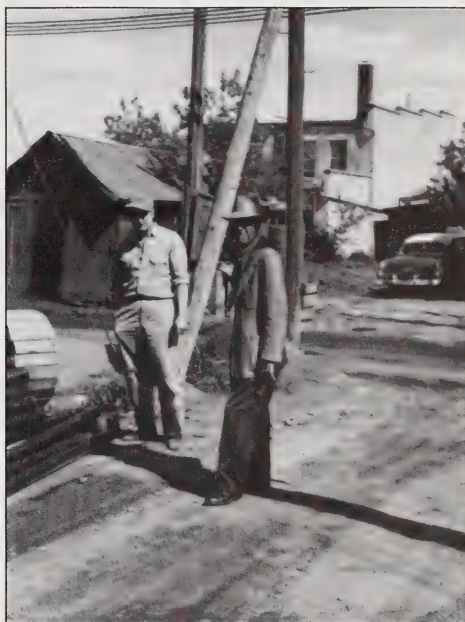
Transmission Group: George Bidulock, Ron Kalvaitis, Al Shelton. (1960)



Lethbridge airport: Bob Reid. (1959)



Vermillion: Dave Corbett, Ben Wilson. (1957)



Vegreville: Cam Campbell, Tom Goodsir. (1957)



Transmission office: Lorne Baker, Al Emeny, Don Shand, Vaughan Monson, Harry Mandryk, Cal Vandergiest. (1958)



Grande Prairie: Chuck McGregor. (1959)



Transmission office: Bob Sutcliffe, Doug Netterville. (1958)



Edmonton: Don Shand, Norm Williams, Dale Walker. (c. 1960)



Lloydminster: The Reid Brothers, Jack and Bob. (1962)



Vegreville: Jim Barnes, Jack Childs. (1956)



Edmonton Toll: Bert Collins, Don Stewart. (1952)



Banff: Ken Green. (1956)



Edmonton: Bill Baas. (1957)



Lloydminster: Reg Skitch. (1953)

*The People
of the
Network*

A Beaver to Fort Chip

THIS IS an account of a trip I made to Ft. Chipewyan with Keith Stonehouse of the Plant Department and a representative from DOT (Department of Transport).

We went to clear up interference the local AGT PABX was causing in DOT radio equipment. The trip was made in the dead of winter by chartered aircraft.

In preparation, we gathered together as much polar equipment as we could carry. This included parkas, flight boots, sleeping bags, army rations, compass, stainless steel mirror with a hole in the center for signalling to overhead aircraft (I was certain I'd need this), test equipment (along with many things that could be used for taming a PABX that was spilling out noisy interfering electrical pulses) and of course, gum boots (well, you never know).

The aircraft was a Beaver, a single engined high winged monoplane equipped with skis, chartered from Gateway Aviation. It came

equipped with a tall, lanky, most capable pilot. There were seats for four people including the man at the helm. The plane had a large compartment for luggage, and we made use of all of this space. I could see right away why the plane is called the work horse of the North.

When I climbed into the cockpit I found myself sitting beside the pilot, almost in reach of the whirling propeller and behind a deafening engine. It didn't take me long to feel lonely and scared, as the small plane bored its way through the blizzard-charged clouds high above the earth. The pilot eventually dropped the plane onto a landing strip at Ft. McMurray. We taxied around the perimeter to a cache of gasoline. The pilot climbed out and filled up the plane, then once more at the controls, he coaxed the craft back into the remote bleakness of the winter sky. We headed north — anyway, I think that's what he shouted. After half an hour or so, he motioned that it was no use; we'd better be turning back, it didn't seem to be letting up.

Just then he spotted a light patch of sky, and shouted, "We'll give it one more go. Up and up we spiralled — suddenly, as if caught in a search-light ray, we were cast on top of brilliant sun-lit fleece of storm cloud. This was now exciting ... the shadow of the small plane tip-toeing from cloud to cloud. We winged on to the monotonous drone of the big engine.

Soon the clouds thinned, and patches of forest lay far below. The pilot was experienced, as his navigation put us directly above the Athabasca River. We'd been following it all along.

"I'll drop 'er down", he yelled, so down we slipped until things took on living perspective. We saw moose, deer and several animals of prey. There were tracks of snow shoes and a dog sled. Once when we were over a herd of buffalo, the pilot yelled, "We'll give 'em a thrill," and he dropped lower until we could practically touch their manes. Buffalo scattered in every direction awed out of their wits at this noisy bird. Shortly, he shoved the throttle ahead and we climbed, once more heading for our destination.

Eventually we circled the small settlement of Ft. Chip., lying in a Christmas-y setting, a most welcome sight below.

The pilot turned to me and said, "See that crank there...crank down the skis and I'll set 'er down."

I cranked and cranked. I thought they'd never come down. Just when it would turn no more, he motioned "that's it". He lowered the plane

to the snow-covered ice of Lake Athabasca, and we taxied to shore.

When we stopped, we shoved the door open and found the whole village out to meet us. It was a mixture of humanity with one thing in common: everyone was dressed for 50 below zero. It was nippy!

*A Beaver
to Fort Chip*



R. J. Moore on way to Ft. Chipewyan. (1961)

From the comfortable cabin of the plane we were greeted by the onslaught of frigid, still air, "breathtaking", in the true sense of the word. Dogs were barking, people were jabbering and waving with friendly gestures. Out of the group emerged a young Chinese fellow who told us he would take our bags and things to his store — he had a place for us to stay ... over his store.



Dog Team: Ft. Chipewyan.

This store was a place where you could buy a meal, a rifle, pair of pants or a can of beans; it had everything.

With a smile, he held out his hand. "Name's Harry," he said.

Soon he had us sitting in a booth with mugs of pitch black coffee in front of us. It hit the spot. Then we heard the sizzle of steaks in a pan, and they too hit the spot. From then on it was buffalo every meal - we didn't complain. To the people we were most welcome, we were from the 'outside', and we'd come to do something for them.

The next morning I contacted the DOT officer. Their radio equipment and the AGT switching apparatus were located in the same building with only a partition separating each installation.

I listened to the receiver and could certainly understand why they were alarmed — every time a phone call was placed in the village, the radio message was wiped out. The DOT operator used Morse Code to send his messages back and forth, and this was virtually the only contact with the outside world. When the noise came on, he had to listen to the pulsing noise instead of the clear musical signal. He was a good operator and walked around the room at times copying messages even amidst the raucous telephone noise.

I went to work on the PABX and after much adjusting, tightening, scraping paint off for better metal bond, placing capacitors in various places and running ground wires to the shallow well at the back of the building, eventually lowered the electrical interference to tolerable conditions.

My Chinese friend, as if drawn by a magnet, was nearby every minute. He handed me tools, ran little errands, and assisted me in many ways. Once I made a remark that I wished I had some copper screen. I didn't think much about this remark but shortly missed Harry. I turned around and he was standing beside me grinning.

"I get you copper screen!" He was holding a large piece of bright new copper screen — where in the world it came from I'll never know. We proceeded to cut long strips of it, and I placed these between the panels of the metal cabinet, then tightened the bolts making good electrical contact to both surfaces. This helped a great deal and made the DOT operator quite happy.

In the north, people make do with the resources they have ... even taking on a multitude of different jobs. The radio operator, for instance, was asked by the RCMP to handle trial duties while he was there — in the

adjoining room to the one where we were working. He told us that the day before he had to go out someplace to patch up a sick horse — another day he helped to pull someone's tooth. There was no pay for this extra activity, but just think of the experience.

Apparently Harry had travelled to Edmonton sometime previously, and on spying a beautiful big new Oldsmobile car (deluxe and with all the trimmings), decided to buy it.

He related, "I spread money out on car and told salesman I take."

The salesman fainted, I guess, and they had to get another guy to make the deal. Anyway, the car was soon on its way to Ft. Chip using many forms of transportation, including a barge up the Athabasca.

Harry was waiting and had a garage built. You should understand that Fort Chipewyan at that time had only one mile of road (rock and gravel), but Harry had his own thoroughfare — he'd cleared a big circle behind his store, and he spent all of his spare time polishing the car, or driving around in the circle.

I asked, "Harry, why don't you come to Edmonton to live?"

He replied, "No! Here everyone my friend, I don't even lock doors of store. I trust the people — I like them — they like me."

This was my experience of Ft. Chip. We packed to leave. However, the pilot had to work for several hours using huge gas heaters to thaw the engine out. Eventually we climbed aboard. He throttled ahead, and in a cloud of snow taxied for take-off. We were soon heading south



Restoring track on RCMP bombardier at Ft. Chipewyan. (1961)

high above that winter highway. Once more, sitting beside the pilot and accompanied by a noisy drone, I marvelled at the conditions in this remote settlement, an experience and a lesson in gratitude rolled into one. Memories of the minus 50 temperature, the clear crackling air that made hearing possible for miles, the dog teams tied outside the Hudson's Bay store (huge huskies that eyed my every move). I also thought of the afternoon we'd decided to go to the top of the hill where the radio site was located.

We'd contacted the RCMP and asked them if they would take us up in their Bombardier. About halfway there, the machine slipped off

the trail and nearly rolled over. Everyone piled out and tried to get it back on the road. Eventually, it walked itself right out of its tracks (it was a caterpillar type). There was only one thing to do — get more man power. About twenty-five husky Indian lads were summoned, and even with much tugging and pushing nothing was accomplished. I remember one young fellow stepped off the trail and dropped out of sight in the snow. Keith and I decided to go down by foot. It was a long cold journey, with snow so deep and the mercury below sight.

A trip to remember.

*A Beaver
to Fort Chip*

Chapter 18

Miscellaneous Tales of the Trails

JUST about the time the 'J' carriers were being turned up for service, Bob Meikle and I were out on some last minute work. It had poured rain for three days, and the ditches were filled with water. Bill Russ, the Calgary District Plant Manager, was out on an inspection tour. Bob and I happened to meet him on the road opposite the Didsbury repeater station. The barrier of water prevented his further progress. It was like a moat around a castle. Bob was always to the rescue in cases like this. In a flash he walked over and picked Bill up, carried him across the ditch and plunked him on the other side. Bill was too surprised to say a thing. Of course, Bob had to carry Bill back after he'd inspected the office. Bob then spent the next half hour cleaning his shoes and drying his pants.

It wasn't long before the 'J' carrier finally got turned up and started to bring in money. We still, however, had to contend with iced-up wires and hoar frost. This caused excessive attenuation of the signals, in many cases making them

unusable. We dreamed up many theories for getting rid of the frost. The odd method was actually tried. One suggestion was to apply electricity to the wire to heat it up — but just imagine how much power would have been necessary to do any good. Another was to go down the route with a sledge-hammer and give each pole a heck of a whack to set up a vibration to loosen the frost on the wires. It might have worked if you had an army of coolies each smacking a pole. Still another suggestion was to use an aeroplane and fly it over the wires in just such a way that the back-wash from the propeller would blow the hoar frost off. Gib was all for trying this!

On one occasion I was down at Fort MacLeod on a very windy day. I had to 'hook up' at the terminal pole as I was going to do a X2.7 toll entrance cable loading adjustment of the short toll entrance cable. It was a circular terminal, so it had a round cover. I carefully removed the cover and went down, placed it at the foot of the pole, then climbed up again. I no sooner got to the top when the wind picked up the cover and sent it rolling down the street. I never did catch up with it, and as far as I know, that cover may still be going. That wind in Fort MacLeod howls like a banshee.

Here's an amusing incident which had to do with one of the fellows working in the East exchange office in Calgary. Somehow he'd become interested in growing flowers. It started through a competition that was set up for keeping the premises neat and tidy. An award was offered each year for the best-kept telephone building and yard. Interest grew to the extent that this guy even specialized in growing flowers like sweet peas ... he even won a few prizes at flower shows. Now his telephone job, along with keeping the switches in the east exchange clacking harmoniously, was to look after the switch board at the Burns Meat Packing Co. in the Ogden district, some 15 blocks away. He'd make the trip once a week to carry out these maintenance checks. On one such trip he got the idea of taking along a couple of buckets, and placing them under the discharge trough of the slaughter house. After all animal by-product was reported to be mighty fine fertilizer. He made many trips that summer, always with two slippy buckets on the jiggly old street car ... he said he certainly had no trouble getting a seat to himself. I know for a fact that the east office soon had prize winning flowers that couldn't be matched.

One day in the spring of 1948, trouble cropped up on the Calgary North toll entrance cable. Art asked me to get hold of Fred Waterman and investigate. The cable, in this case, was an H88 loaded toll entrance cable. This work had apparently been supervised by Mr. Mason during the war years, and it was likely the first of this kind in AGT.

Fred figured the trouble was in a manhole on the Centre Street bridge, which should better have been referred to as a pigeon roost. I remember we hung there above the water for some time with irate pigeons flying every which way.

Fred got out his knife and bared the sheath, opened the splice, and started buzzing out pairs. He searched around and finally came to the one he wanted.

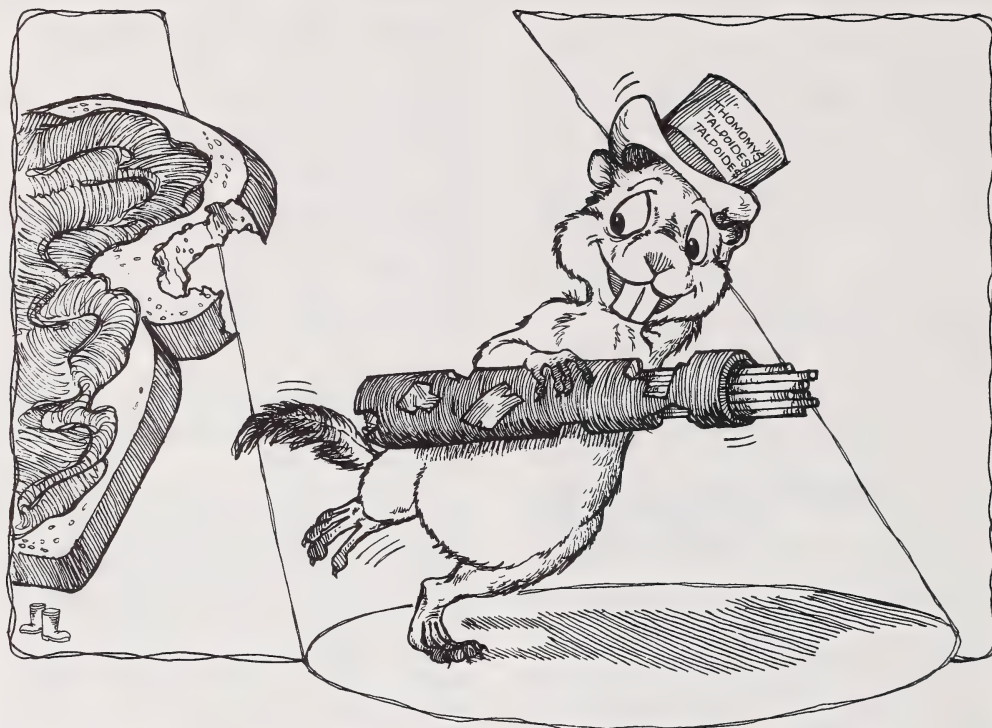
"What the heck?" he muttered. "What are these things hanging here like a bunch of wires someone left behind?" Fred held them up and examined them with an intrigued and inquisitive eye. With a flash of his snips (and a cable splicer could lose his papers if he was caught without his snips handy in that special leather pouch attached to his belt) they were gone. He tossed them far over his shoulder into the gurgling water below, saying "We don't need them bl---y things."

It was not sure what they were, but the splice was now devoid of all lumpy extra bundles of wires or whatever.

Fred found the trouble, so back to the office I headed to report to Art. I made one big mistake, though, by saying, "We found some queer things in the splice. They looked like wax-coated wads of something with bundles of wires attached. We cut 'em off."

Well! This is the closest I ever came to drawing my pay. Art lectured me for twenty minutes, all the time pacing around in a tight little circle. He did all the talking, and I did all the listening. His lecture was well punctuated and not at all technical. He then told me to go and measure the crosstalk of all loaded combinations in that cable because I'd cut off the V.F. balancing capacitors. It was like being made to write "I must not do it again" a thousand times on the back of an old barn door.

After that episode, I spent a good part of the spring of 1952 working with Don Lane in Red Deer, splicing and testing the north and south toll entrance cable. The job went along pretty



well, and was nearing completion, but Don had some vacation coming, and decided to squeeze it in before finishing the job. He sprinkled the exposed pairs of this last splice with great quantities of desiccant, wrapped them with several layers of rubber cloth, bound the whole thing up tight with wire, said a prayer and took off. Almost immediately it started to rain. It continued for what seemed like forty days and forty nights. The streets filled with water, the creeks overflowed, some basements showed signs of flooding, and the manhole filled to the brim. The open cable was soaked, despite Don's precautions. He had an awful job when he got back, trying to coax the water out of the cable. He finally got things under control, but to this day he cocks an eye skyward whenever a black cloud appears and wonders if some poor splicer has got caught with his splices open.

Our first cable air pressurization was on toll cables. What a time the cable splicers had in some cases, sealing off air leaks at splices. This was especially true if the lead became too hot when the splice was being wiped. This would burn the sheath of the cable, then pin holes

would form, and the cable would not hold pressure. Some splices ended up with a lead sleeve over the first sleeve, then another over that, and even another over that. It was rather rare — definitely not recommended — but I know it did happen.

When the rural cable system was being installed in the '60's, some of the cable was dug up. Numerous small cuts were seen in the cable sheath. On closer examination, these cuts had nicely scalloped edges — as a matter of fact, they had a marked resemblance to marks made with a pair of small incisors. It was determined that indeed they were made by some curious rodent who likely thought he'd come across a winter's supply of liquorice. The telephone guys figured there was nothing left to do but capture one of the little citizens and have him researched. In remarkably little time, two intrepid engineers arrived back in the office with a scared little creature in a wire cage. They thought he was the kind that surely was playing havoc with the cable.

Investigation at the University of Alberta determined that it was a pocket gopher, and to

put things really straight, he was really a *Thomomys Talpoides* (a Northern Pocket Gopher). He was given the Christian name of Henry.

Henry was pretty shy, and didn't understand that he was supposed to light right into the cable that was being fed him. As a matter of fact, he didn't have any desire to eat cable at all, and it took many days of dieting before he was persuaded to eat anything. After that, Henry would stand up and beg and perform many little stunts for a small piece of peanut butter sandwich or cake.

The study of the pocket gopher and his interest in buried cable continued for some time. Reams of carefully kept notes were made of his eating and sleeping habits and a voluminous report was then written on Henry, the 'hep' gopher who was supposed to eat holes in cable.

If I remember correctly, the net result was that damage to cable sheath by gophers was found not to be too severe; this once more restored sleep to the Engineers who had made the initial decision to bury cable to rural areas.

I am not sure what happened to Henry. It's possible he was returned to the confines of a cable trench to enjoy the rest of his days in peace. At any rate, he could enjoy the feeling that he had been the centre of attraction in a big office building where he'd hob-nobbed with many dignitaries and had tasted many different tidbits from people's lunch bags. He possibly related such experiences to new generations of *Thomomys Talpoides* with chirpy words of caution.

It wasn't long after the Northern Pocket Gopher mystery got tucked away than we were faced with another startling event. It too seemed to spell doom to the well-advanced 'plow in' of Rural Cable. Once more, Taylor was on the receiving end. He came fuming into the office one morning with a well punctuated oath.

"Dammit, look at this cable! It's full of holes, and look . . . it's wet inside. I wonder what's causing it? Boy! If we have much of this out there we're in trouble."

This brought several engineering heads together, with the final speculation that lightning or high voltage was sneaking into the cable and going to ground through the jacket.

In the group of puzzled staff were two very enterprising people, namely Don Myrthue and Jerry Prystajekyj. They became most absorbed with the problem.

"Hey! I got it!" Don blurted. "Tell ya what, I'll work on it some more tonight ... I've thought

up a way to find them holes, real easy".

The next morning he arrived all grins, a bit bleary-eyed, a pair of what looked like grappling hooks hung over his shoulder. In no time he was demonstrating them.

"See, they're just like crampons as used by mountaineers ... however, the spikes are pointed and all of 8 inches long." Strapping them to his boots and then standing on what looked like short steel stilts, he said, "See, we'll just walk along and make good electrical contact with the ground."

"Now! Here's how it'll work. Jerry and I will each have a pair. We'll connect them together with flexible wire in a way that we can still take steps, then we'll connect a meter between each set. Say we use about 200 feet of wire. That way the voltmeter will be connected in series with each pair of crampons. Then we'll put high voltage on the cable pairs. The other end of the power supply will be connected to ground. If there's a hole in the cable sheath there'll be dampness in the cable and some electricity will flow out through it to ground. It'll flow along the ground back to the power supply. This'll show up as voltage along the ground and we'll see it on the voltmeter as we walk along."

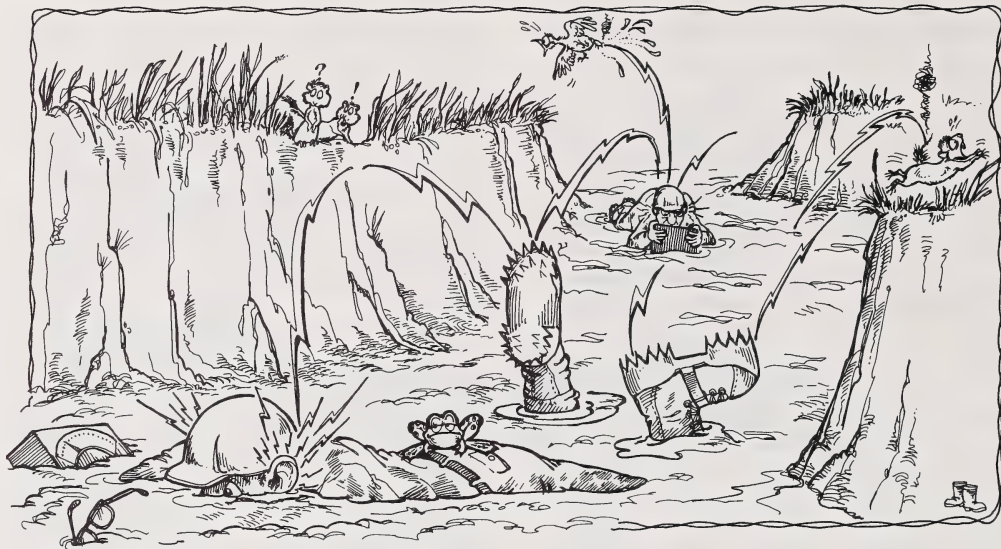
About this time, Jerry had taken off leaving word that he didn't want anything to do with wild contortions of the mind, and that he considered himself too young to die — and anyway, he was a low voltage engineer who didn't work on anything over 5 volts.

Don finally got him to come back by devious promises. He also remarked, "We can borrow that big old power supply that Moore's got in his basement ... it should work like a hot darn."

After some more fast talk he had Jerry quite enthusiastic ... Jerry even got down to picking a site, a place where they could make man-made damage, which came complete with an oozy ditch of mud. It was perfect for this Benjamin Franklin-type experiment — deep with viscous gumbo and slew water — electrical connection should be ideal. They rigged everything up and set out to become heroes.

Don led the way, as Jerry trailed some 200 feet behind. Each step brought a new section of ditch under test. Surely, if electrical current existed, the meter would flicker. They plodded on. With each step they kicked clods of mud high in the air with the spike-cleated boots.

Suddenly, and as in best made plans, with a sideways, prancing manoeuvre Don tottered headlong into the mud. This tightened the wire,



sending Jerry sprawling to his knees in a 'praying mantis' position. It was an especially mucky place. The voltmeter to this day shows permanent evidence of its trip through space, saved only by its cushioned landing of foot-deep mud.

As Bob Taylor related afterwards, "You should have seen those two clowns high-stepping it down the ditch — Heck! You could see blue corona outlining their ears."

This escapade spelled "finish" to a brilliant experiment of electrical cleverness: to find the holes in cable, that to this day, have not been proven to be caused by lightning, rural power or wire worms.

Anyway, that was the end of the experiment to try and detect holes in the cable sheath. It was a real good theory that even looked good on paper, but had a bit of practical oversight. The rural cable program went on without serious trouble.

Although this next event is not about interference into cable, wires or telephone equipment, I wish to include it. It's one of those things that happen that make you wish you were in possession of a one-way ticket to a far-off jungle.

It was brought back to memory at Russ Crawford's house when I visited him a short time ago.

The story unravels like this — and I wish Russ could write the account (mainly because he most admirably handled the event).

Every once in a while, Russ came out in the

field to see the job for himself. It was on one of these occasions that he travelled to Sundre, as Art and I were there. We were trying to get the Olds-Sundre radio link working.

The radio was in a building on a hill a couple of miles away. The rest of the equipment was located downtown in the hotel in a small, dark room under the stairs, right next to the coffee shop and normally used as a cloak room. We were having an awful time tracing the wires in the dark and trying to determine the pin connections on the terminating block. All of a sudden Russ took off for the hardware and was soon back with wire, socket and light bulb.

He quickly had an extension light fixed up, and we were now really in business. Around about noon we had the job nearly finished — we had everything working. Feeling elated about the whole thing, we decided to have lunch. We put our tools down, hung the light on a coat rack, pulled the cord out of the wall socket and away we went.

After lunch we returned to clean up the job. I plugged the light cord into the socket and started tidying up connections and the like. Soon a strong smoky odor, something like barbecued muskrat, drifted across the room. Russ sniffed the air and instantly shot for the light bulb.

Apparently some lady arrived while we were having dinner and had hung her coat over the bulb. Now that I think of it, Russ should have really raced for the door! If you don't agree, by Gawd, just try confronting an irate woman who's

had her fur coat blistered through by a 100 watt bulb!

It was sometime before things calmed down, though Russ was holding his own very well until her husband arrived. Russ, being the world's best diplomat, handled the situation nobly. I am sure that the worst part of the incident came, though, when he related the story to Mr. Mason, the Chief Engineer. The net result was a new coat for the lady, a nice new fluorescent trouble light for us (complete with guard), and a repaired radio system. We were also told that the next time, if there was a next time, we would be making a present of a fur coat out of our own pockets.

After that, I had many trips back to Sundre, as I did the trouble-shooting on this radio for some time. I always remembered the coat episode, and still marvel at how neatly that hole through the coat resembled the outline of a hundred watt light bulb.

Here's another epic which just has to be told. The setting was Fort MacLeod, sometime in the summer of '53 around the time of our open wire 'J' tests. I am going to refer to our stars as A.C., V.R. and Dave, not to protect the innocent, but the guilty. Two other important individuals, not clearly identified, also took part.

It was one of those hot, dusty, windy, hard-to-work-on-this-account days. The guys had been busy working at the nearby 'J' repeater station from early morning til late at night. They'd finished their testing and gone for supper. On their way back to the motel, they spotted it — the town swimming pool. It was made to order. Why not have a plunge and cool off? The reply was a chorus, even with A.C.'s favourite saying: "Sounds like a fine idea!"

The first problem was to get over the high wire fence surrounding the pool. This would take several minutes, as it would be difficult to climb — but telephone men meet all challenges. It wasn't long before V.R. and Dave had scaled the barrier. V.R. sauntered over and dipped his fingers into the water. He let out a "Yoop!"

"Jeez, that's cold..." he said, as he started to strip.

Dave was already set, and dived in, followed immediately by V.R., who made a splash that emptied several gallons from the pool. They were soon having a wonderful time splashing and wallowing around, like a couple of African hippos.

A.C., however, (always the cautious type), for some reason was slow in climbing the fence. He

said something to the effect that the toes of his boots wouldn't fit into the holes in the wire mesh. At any rate, he finally got to the top. Stopping momentarily, he was caught in a beam of light ... he heard fast-approaching footsteps... a shout resounded: "Hey, You guys! Get outta that pool!.... Stop!... Police!"

A.C. spun and leaped into space. "Cops!" he yelled. "Scram!" Just then he made out some faintly lettered words on a sign... POOL CL..... He didn't stop to read further, but headed out in overdrive across what used to be Indian country.

V.R. and Dave, on the other hand, were in a heck of a predicament... stark naked, dripping wet, in the pitch dark, behind a high fence, with two constables tearing along the wooden sidewalk in the direction of the pool.

It's here I've found it hard to piece together an account of what happened. Several conflicting stories cloud the issue ... anyway... VR claims he was over that fence first. He says: "Man! I made it outta there in three toe-clawing strides. I leapt to the ground and took off. I didn't know what direction I was going in and I didn't care." He continued, "The police were not far behind, and jeez ... I thought I heard a dog!" (Just imagine the colourful thoughts he must have had ... hot canine breath ... bare rump ... sharp fangs ...)

Dave said that he followed close behind, that he clawed his way up the fence, then jumped and streaked away dragging his clothes. He said, "I soon caught up to V.R., but Gawd, how that kid can run! I heard him mutter something about dropping one of his shoes. I yelled to him as I passed, 'Hey, V.R. — How'd you get over that big hedge back there?' He roared back, 'Heck, I didn't! I ran right through it!'"

The police kept sweeping their big flashlights back and forth, periodically catching our heroes in the light, their dripping outlines making fleeting patterns against a coal black night.

A.C. was caught in the beam and froze in his tracks, becoming part of the woodwork of the building he was beside.

The police finally broke off the chase, likely for several reasons. Either they had other things to do ... or they were sure the swimmers would never return ... Or they were so weak from laughing that they couldn't hold up their flashlights.

Yes, many off beat things happened while carrying out the duties of a field engineering force. Many other tales of telephone travel could be

unravelling to expose events of note — not exactly of a technical nature, but certainly part of getting the job done. I am sure each person has a collection of personal treasures.



Camrose: 1-r, Ron Bakken, Bob Sherback, Gordon Shantz, and Richard Stewin. (c. 1965)

I will leave it at this, but if pressed, could relate another one or two — however, not without oath and a clearly identified license to limit circulation.



Vern Ogilvie, Bob Meikle, Bob Reid, Jack Lawrence: In front of Wainwright Office. (c. 1955)

Transmission Becomes the Thing of the Day

ABOUT 1951, when the new look of telephone design and implementation started showing up, a great deal of field work had to be done with channel alignment.

This boiled down to correct adjustment of sending and receiving pads to obtain proper transmission levels, assuring good volume and echo control. The values for these adjustments came from Circuit Layout Cards showing requirements to a high degree of accuracy (0.1 dB). As a result, many things could contribute to error and incorrect readings. Every effort was made by the staff of our Transmission Engineering Section to ensure that nothing was overlooked. A slogan was picked up by someone, somewhere: **“ANYTHING THAT CAN BE ADJUSTED, CAN BE ADJUSTED WRONG — BUT IT ISN’T NECESSARY”**, which led to its corollary: **“ANYTHING THAT CAN BE ADJUSTED, CAN BE**

ADJUSTED RIGHT — AND IT DOESN'T COST ANY MORE"

These two slogans became universal sayings for years in our group when we carried out transmission work. I would like to bring them back, as they aptly describe the adjustment accuracies of those days, and particularly so today.

In 1958, Mr. Losie informed the Engineering and Plant departments that we were to establish a permanent committee, consisting of Plant and Engineering members, to work together on problems and improve the transmission of the network. He had just returned from a TransCanada Telephones conference, bringing with him many ideas on an extended effort from all member companies.

This took us back many years to a time when Russ Crawford started a "blitz" to improve transmission. It was true that people could talk over the telephone, but in many cases they heard the signal as if it were boring its way from Mars.

The work of the 'roving' Engineering Transmission Crew we'd started had now been passed over to the Plant department; they in turn established separate crews for Edmonton, Calgary and Lethbridge with the express purpose of improving transmission. They did a noble job, as the many toll routes were checked and double-checked, using the procedures and tests thought up by Art, Gib and myself in the Transmission section. Now, a more coordinated effort was to be conducted that would be all-encompassing, one which would now tie in with TransCanada.

The committee, started in 1958, was formed by the Plant and Engineering departments, and was to be known as PETIC. It was made up of the following members: Harry Allen - Plant (Chairman), Lee Harrison - Engineering, A.C. Gibbard - Engineering, H.M. Turner - Plant; M.H. Megley - Engineering; and myself from Engineering.

Terms of the committee were laid down and we went to work. The following information has been extracted from the minutes of the first meeting - June 19, 1958.

MEETING NO. 1 June 19, 1958

Minutes of meeting of Transmission Improvement Committee, held in Mr. M.H. Allen's office on June 19, 1958 at 9:00 a.m. Those present: Messrs.

M.H. Turner, M.H. Megley, E.L. Harrison, A.C. Gibbard and R.J. Moore.

The meeting was opened by Mr. Turner who outlined some of the reasons for calling it. As this was the initial meeting for the committee, some thought was given to an appropriate name, as well as its terms of reference.

It was decided that the work would fall into the following two phases:

- 1. To initiate an up-grading of all existing toll circuits from the transmission standpoint.*
- 2. To maintain standards of all new circuits.*

A discussion followed to decide what procedure the committee would follow in carrying out this work. It was thought that a Plant Bulletin should be issued along the lines of Bulletin #17 to show procedures of reporting acceptance and maintenance results of Circuit Order work.

- 1. When this Bulletin is available, it will be sent to all personnel so they can acquaint themselves with the procedures.*
- 2. A lecture will be held for personnel associated with this work, this will be in the form of an appreciation course following methods introduced in B.S.P. E26.040. It has been considered to ask Mr. Kemp of the Bell, to conduct these courses. This was mentioned previously by Bell as being possible.*

Further discussion resulted regarding courses to be held to take care of the three districts of Edmonton, Calgary and Lethbridge and that a personal visit to control centers be made by someone to point out the need for this and to stimulate interest in transmission work.

Mr. Harrison mentioned that new Circuit Order cards would be prepared for the Calgary District first, as this district would be the first to cutover; followed by cards for the other districts.

The increased number of measurements on circuits which would have to be made to bring them up to standard, as well as initial lineup, etc., this would put a heavy demand on availability of test equipment. It was therefore decided that an investigation would be made to find out what test equipment was on hand and what additional equipment would be required. Mr. Turner would start this investigation and report on the matter at the next meeting.

The meeting was adjourned at 4:45 p.m. To be continued Thursday June 24, 1958 at 9:00 a.m.

MEETING NO 1 (Continued)

Minutes of meeting held in Mr. M.H. Allen's office on June 24, 1958 at 9:00 a.m. Those present: Messrs. M.H. Turner, M.H. Megley, E.L. Harrison, A.C. Gibbard and R.J. Moore.

Item 1. E26.040 Maintenance Procedure

The programme of circuit testing will be started by processing all circuit orders bearing dates of June 1958 or later per BSP E26.040, Form E2545. Form E2545 will also be used for re-issued cards.

Item 2. In-Effect Report

All "in-effect with exception reports", will be reviewed at each committee meeting along with a study of the progress report.

Circuits which do not meet the requirements of E26.040 will be reported by letter, the control center making the test. This will afford a record of any fault, enabling it to be reviewed by the committee until it is cleared.

The meeting was adjourned at 11:30 a.m.

After this, the committee went on to handle items such as the following: Terminal Balance, Office Balance, Test Equipment, Inventory of test equipment, along with the maintenance and calibration of test apparatus. It included the dust problem in the Edmonton Autotoll switching machine, Milliwatt calibration, E.M.L. program, Dial through testing, Connection appraisal, Grounding and bonding, Automatic Transmission routiners.

One of the biggest jobs, however, was to sell the idea of transmission improvement to the Plant people. Morley Turner and I were assigned the job of making a province-wide trip to Plant offices to explain methods for improving transmission. It was just the year before that the Engineering Transmission section had been transferred to Edmonton from Calgary for virtually this very purpose.

In 1960, I was promoted to Engineering Supervisor — Transmission. This new section would guide the transmission work, especially things like terminal and office balance, noise investigation, milliwatt level calibration, VNL and EML, and later included Connection Appraisal. Don Hunt, a member of the section, set this up and got it under way. Avtar Dhalival then headed a task force for improving grounding and bonding. This was right across the province, and mushroomed into a full fledged grounding 'clean up' throughout the network, including new practices and procedures. Other people on this task force were Andy Coyle, Neal Robertson, Rod McPherson and John O'Neill.

The number of incomplete Circuit-Order cards soon dropped. A Sub-set Zoning Plan was put into effect, creating uniform receiver volume throughout Calgary. Along with this came trunk-

loading (H88) and trunk design by D.C. resistance methods. People soon were experiencing a 'New Listen' in telephone use — the action of the committee was now bearing fruit. Closer working relations of Designer and Maintenance man were brought about, along with better problem feedback. The committee shortly had a traffic member on it as well, and soon AGT subscribed to the nation-wide 'Transmission Results Plan', which published performance figures for all companies. It included operating parameters such as 1000 cycle Net Loss, Dial Through Results, Noise, Echo Return Loss, Outages, etc. A method of Black-Dotting offices with persistent problems allowed them to be identified for individual attention. The coming of 'Direct Distance Dialing' (DDD) made it necessary to have all equipment in top-notch shape, because there was no operator now to come to the rescue to switch a call to a better circuit when the listening got tough.

'Service Observation' also came into effect. This helped determine if connections were made properly through switching machines. The results of other companies were also published, and this stimulated competition to provide better telephone service.

Of course, one of the main causes for all the effort was the Division of Revenue (DR). This is the splitting of payment to each company where long distance calls traverse their network, using the equipment each provided. One can vision a huge simmering pot; the dollars from each long distance call are thrown in, then shrewd, beady-eyed accountants fish for their share of the loot. Money is still the thing that makes the electrons flow in the cable of a telephone company, and much effort is needed to ensure proper division of the wealth.

February 13, 1967, saw further steps towards improvement. A team of people representing all Trans-Canada Companies toured Canada, inspecting each company's operation. A report was subsequently issued on telephone quality and service ... much was learned from it.

Ron Kalvaitis of AGT was on the TransCanada team and assigned AGT inspection. I accompanied him for the three weeks. We checked everything from DC to Microwave, Manholes to Equipment Rooms, and Circuit Orders to Acceptance Practices. We talked to people about telephone operation in many offices; watched them carry out daily inspections; saw them troubleshoot from their 18B and 17B Test Boards. We looked over their Circuit

*Transmission
Becomes the
Thing of
the Day*

Layouts, talked to them about test equipment and its maintenance and calibration. We brought back a host of problems that had no simple answer. Ron then went to work on his report.

From the Trans-Canada committee stemmed the M.E.T.S. committee, (Maintenance Engineering Technical Sub-Committee). This today has a regular member from each province. AGT, like other companies, also has its working committee called the Transmission Improvement Committee. This meets once a month to review problems, monitor results and check performance. Service is the 'name of the game' and this committee is still the guiding light.



Transmission course Jasper Place Exchange: (by rows from front, l-r) front row: George Bidulock, Lou Dytyniak, Al Shelton; second row: Jim Metcalfe, Jack Childs, Dave Mills; third row: Bob Taylor (behind Jack), and Dave Thompson; back row: Stu Bertles. (1966)



A Banff Management Training Class: Jack McDonald (instructor) and class counter-clockwise from upper left - Dave Edwards, Jim Stace, Ken Tye, Gordon Bell, Gordon Alexander, Don Tangen, Barrie Fryette, Steve Kereluk, Jack McCuaig, Bob Kessler, Ron Reed, unidentified, Jim Cobb. (1966)



Edmonton Transmission Office: l-r Joyce Melnychuk, Ruth Sawchuck, Joyce, Vicki Zuk (back), Marlene Locken, Donna Fee. (1957)

Snaking the Telephone Cable Along the Ditches

IN 1964, AGT and Mutual Telephone Companies of Alberta (roughly 1200 strong) to an agreement that swung open the doors for improved telephone operation, in keeping with the DDD plan. It would eventually do away with all open wire telephone lines — lines that were now in need of new poles, insulators, brackets and the like. Wire was often sagging like skipping ropes; iron wire introduced great amounts of attenuation, resulting in many shouts of, “What did you say? I can’t hear you, talk louder”, or remarks like, “We’d better hang up — I just heard a click, someone’s buttin’ in”. There wasn’t an ice-cube’s chance in Hades that lines like those would work for an automatically placed call. AGT Engineers, like Bob and Gib, went into a think session to decide what could be done. It became obvious that the lines would have to go — ‘plowed in’ cable was the answer.

Actually, there’s a lot more to the story, as the government became involved; however, the outcome was that AGT took over almost every

company and established a modern telephone network using underground cable.

In 1964, after all the paper work was sorted out and signatures placed on documents, AGT went out to bid for plowing cable. The first areas exposed to the big yellow 'cats' pulling plows were Mannville and Vauxhall. In all, there were nine Plow Companies bidding on the work, with five being used.

About this time Bob Taylor was Staff Engineer, and it was his responsibility to answer several questions that loomed up. I list some of the important ones:

- The length of the main cable runs
- Maximum allowable length of extensions to farms
- Type of loading to use to control attenuation
- The type of cable to be used
- The splicing methods
- The electrical protection
- The plowing depth
- Where to start plowing
- Acceptance and cutover
- Type of service and telephone set
- Signalling considerations
- Considerations of possible rodent damages.

One of the first things facing Bob was the choice of a loading scheme compatible with a rural cable system that would give good transmission to the farmsteads of Alberta. There was the H88 system, used in cities for trunk cables, which required 88 milliHenry load coils every 6000 feet at a section capacity of .0942 MFD.

The rural plan was to use buried cable from the exchanges in the towns and a party line system with divided line ringing. The old H88 loading scheme has a frequency cut-off of about 3500 cycles. This limited the length of end sections that could be used, as excessive frequency roll-off resulted when it was extended to the more distant farms. Though this scheme didn't look too promising, it was used, however, for the first two plow jobs in Manville and Vauxhall.

Bob still thought there was a better loading plan, and contacted Mr. Lambidakis of the REA in the U.S.A. He was told that a D66 scheme showed more promise.

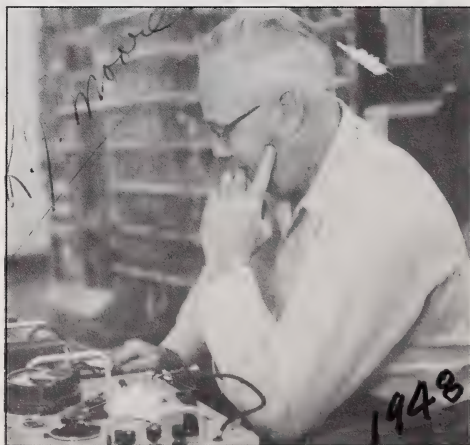
This loading spaces 66 millihenry coils every 4500 feet. It is considerably lighter loading, with a frequency cut off of roughly 4000 cycles, allowing a longer end section which was the important consideration. It seemed to be the route to go, so the Company soon saw the Purchasing

Agent bringing in loading coils for the D66 scheme. It was at least for a trial, but it soon proved out, and the whole network eventually saw a rural cable program based on D66 loading. A comparison of end section length for H88 and D66 is H88 - 9 Kft., D66 - 12 Kft for low capacity cable of .083 mfd per mile. It should be remembered that 4 separate farms would be fed from the end of the main cable. This paralleled the capacity, thus increasing it considerably.

Bob came up with the answers to the other questions as well, and the plows were soon in action, bumping along over the prairie. Bob was always a man of action, he didn't deliberate on a problem long.

He often said, "You can't hang a guy for making a decision so he can get on with the job. One thing I can't stand is the guy who isn't able to make a decision ... he's always waiting for something better to come along ... It never does."

At that time I was looking after Transmission Maintenance. This included everything pertaining to transmission problems in the field. Every problem that people couldn't figure out what to do about seemed to end up in my 'In Bin'. I also had to come up with acceptance practices for the rural loaded cable. Dave Saul, who worked for me at that time, went to work on these.



The Author - R.J. (Bob) Moore. (1948)

To sum up the Rural Plow Program, in all, about 90,000 miles of cable was plowed at a depth averaging 24 inches. It was done by five contractors to the tune of about 10,000 miles a year. There were 1,200 mutual telephone

companies in the province, and all but three were converted to cable.

Now the trend is to ILS (Individual Line Service). The march is on. We will see a marked change now that the digital pulse has invaded the rural hinterlands — the last frontier. It would appear that we've missed the boat and that God really meant us to go around clicking our teeth together instead of making musical sounds in an effort to talk to each other.

Subscriber Carrier should be given special mention. In 1973 (approximately), a decision had to be made whether to overlay rural cable in places where growth was taking place, thus requiring new cable pairs. Keep in mind that AGT was already offering almost up-to-date 4-party service. An alternative method was in the offing: a compact low frequency, *unsophisticated*, (barely tried) carrier system. Its line frequency was low enough for transmission over the relatively short rural cables *after* the voice frequency 66 millihenry load coils had been removed. The frequency range was approximately 30 to 80 kHz in one direction and 80 to 140 in the other. It was a double side band transmitted carrier system that provided 6 voice frequency channels. The first trial of this equipment was near Edson. Then a permanent installation was made in Fort Saskatchewan. Although this equipment did not come into general use until some five years later, it nevertheless was the forerunner of the rural picture to come.

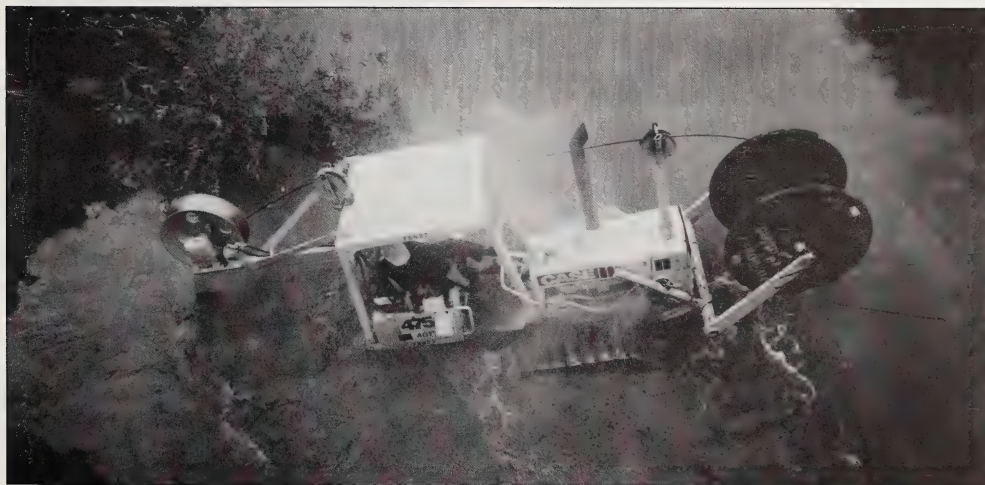
Such a system offered a great deal of flexibility, and much cost saving if service were to be

discontinued for any reason. Basically, it was just like putting a low frequency, amplitude modulated, radio system on wire. The one fly in the glue seemed always to be that a load coil was left connected in the cable pair that was to be used for the carrier. This put a 'hill of impedance' in the transmission parameter and resulted in a gusty arm-waving argument with the cable splicer, who swore an oath that all coils had been removed. Then he was shown that it was not so — that one or more were still neatly connected at some splice.

As of 1978, S6A — Anaconda and CM8 — Superior Continental subscriber carriers saved large dollars that would have had to be spent for newly-buried copper cable. Remember also, that once you put your money into ploughed-in-cable you can never retrieve the dollars. You just hope the subscribers never move. Carrier systems are now going in like popcorn sells at a Disney show. This is certainly the way of the future with added features such as R.I.D. (Rural Interface Device), a gadget invented and patented for that purpose — a brain wave of AGT engineering.

Rural telephone will thus stand in rank with its city cousins, offering every feature of modern usage and transmission. It looks like AGT is now filling the early visions and plans of people like Lee and Russ, in providing all of Alberta with efficient, well designed, modern telephone equipment.

*Snaking the
Telephone
Cable Along
the Ditches*



Cat ploughing across Freeman River, Ft. Assiniboine (1986)

The Engineering Lab

IN 1948, OUR field engineering section inherited several large wooden boxes, each containing what was considered to be delicate test equipment.

I can't vouch for the delicacy of the apparatus, but I can tell you right now it was the heaviest on record. If delicate, then the inch thick oak planking used for the boxes surely protected it against the most serious happening.

There was, for instance, one big box with a brass name plate duly scribed 4A Oscillator; another, a 2A Capacity Bridge; and yet another, also with heavy brass hardware indicating that it housed a 4A Capacity Unbalance Bridge. Then there was a set of three: their name plates, indicated that Impedance-Unbalance Measurements could be made by them. Equally impressive, heavy and surely capable of measurement to a gnat's eyebrow, this assembly was called the 1B Impedance Unbalance Bridge. It consisted of a big fixed inductor, a variable inductor and a decade resistance box. Of course, when

it was used, it was necessary to include the huge 4A Oscillator along with other paraphernalia. This set-up took 10 feet of bench space. Just imagine the problems that cropped up when using it in crowded offices ... as we did from time to time.

I remember that the old oscillator had so much second harmonic content in its signal that on approaching the normal 1000 Hz null of the capacity bridge, the 2000 Hz harmonic masked the 1000 Hz test signal completely, making further nulling impossible.

We also had a 7A Milliammeter and a 2A Noise measuring set (F1A weighted modified from 144 weighting). It was in a heavy aluminum box. However, the large A and B batteries inside made it equal in weight to the heaviest wooden box. There were other instruments as well, like the 10A Noise Analyser, Milliwatt Set, Voltmeters, and of course, things like a climbing belt, jack straps, 2 tents, coils of rope, shovels, sledges, a pick with a special end for taking off manhole covers, portable telephones, electrolysis meters, a 'WWV' receiver, a 5 inch Dumont Oscilloscope, and over in one corner — gumboots.

We lugged most of this equipment and gadgetry all over the province to test and fix bad telephone lines. At first, we travelled by train. The test equipment had to be carried to and from the station, and a truck was rented for taking it to the test site. I should mention that our railway passes for each journey had to have General Manager approval ... things have certainly changed. Trips by modern air craft are now arranged in minutes by a clerk. A Calgary-Edmonton trip by rail was quite enjoyable (after the equipment was loaded) but a trip from Edmonton to Peace River, on the other hand, was some experience. A journey over that muskeggy, swampy, 'jelly like' road brought on spasms of nausea, like the experiences I had when crossing the English Channel in an LST (Tank Landing Craft) some years before.

As time went by we obtained more up-to-date instruments. The next to arrive was a Weston volt-ohmmeter in 1949. It's interesting to know that this instrument was still going strong a year ago ... a bit glued up and with a needle that resembles a reshaped pretzel, but still working! It took the place of the old M9B volt-ohmmeter.

Two Hewlett Packard audio oscillators came next. They covered the range from 20 to 200,000 Hz, and had been purchased for the J carrier open wire crosstalk tests. They too are still

working satisfactorily ... possibly in need of a few new tubes, a sudsy bath on the wash table and new filter capacitors.

Along with the oscillators came two Western Electric 31B selective voltmeters, used for the J testing. It was really something to use these instruments as they had selectivity which we were not used to - about 140 Hz wide at the top of the response curve. They were touchy to tune at first, but certainly did the job. We wore their dials and range switches completely out before the crosstalk measurements were finished. When you stop and consider that we did all combinations of at least 4 open wire pairs in forty mile hops, of the toll leads from Calgary to Medicine Hat, then to the B.C. border and from Edmonton to the U.S. border — that's a lot of testing. But it set the stage for 'J' carrier operation of the near future.

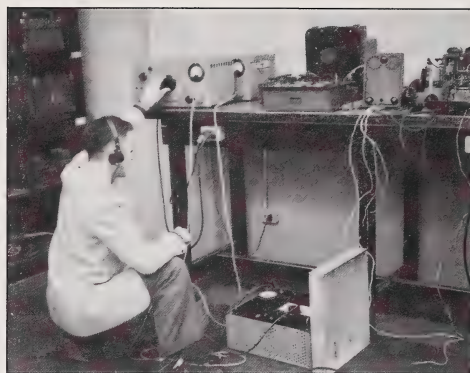
A few other instruments come to mind of the 1950 era:

- 2 Wheatstone bridges (in oak boxes) rewired, reglued, remetered, but still ready for a Varley test.
- 5A Impedance unbalance bridge for J carrier (spiral 4) cable balancing.
- Portable milliwatt supply was an AC generator driven by a synchronous motor. It turned out 1 milliwatt (0 dBm, reference 600 ohms) of 1000 Hz signal.
- 32A Transmission measuring set with an extended frequency range for use on program channels. (600 or 135 ohm input).
- 3A Transmission measuring set used expressly for program measurements within the 15 kHz range.
- 2A Thermo-couple meter, an AC ammeter good up to about 20 kHz.
- 7A Transmission measuring set. A Thermal transfer unit supplying one Milliwatt of DC power to be used as a reference to calibrate a meter scale to the equivalent of one Milliwatt of AC (sine wave) signal. Reference 0 dBm.
- Insulation megger. This was a 500 volt megger. The crank had to be turned fast enough to make the internal clutch slip, which assured that 500 volts was being generated.
- Earth megger. This set measured earth resistivity. Three ground rods were necessary for the measurement (or 4 depending on the particular method). The set used internal commutation. This switched the generated voltage and the metering circuit in unison, thus avoiding the possibility of error due to

earth currents. A lot of sledge hammer work was necessary for ground rod driving. It was worse getting the rods out, though, and brought out much inventiveness on the part of the puller to create a gadget for extraction. Numerous ideas came forth: the best seemed to be one which employed a car jack with flanges welded to it. Driving the rods in straight was also a problem. We tried all manner of ways. One method used a pipe that fitted over the rod. A heavy weight on top was banged up and down, thus striking the rod — we finally went back to the good old sledge hammer, but we went through a lot of hammer handles in the process. Sometimes when driving a rod, the point would come back up almost through the sole of your shoe, it had ricocheted off a rock and headed back to you.

- 5 inch Dumont Oscilloscope — now here was our pride and joy! Not much of a scope in present day standards, but it served our purpose. One of the main uses was that of displaying lissajous figures (or making intriguing green patterns to impress people by putting our fingers across its terminals) for checking the frequency of the 'J carrier' oscillators. To explain further: A very accurate way of comparing the frequency of two sine wave signals — say that of a reference and a local oscillator, is to connect one signal to the 'X' terminals and the other to the 'Y' terminals of an oscilloscope, the time base being disconnected during the test. Now, if the two signals are phase stable and of exact frequency, a perfect circle will be observed. On the other hand, if one signal has a frequency that is different (for example, 1 Hertz per second) the circle on the screen will start to roll or change position at that rate. Measuring the accuracy to a high degree of tolerance requires that the picture be viewed over a long period of time. The number of rolls are counted and compared to the viewing time; from this the accuracy of the local signal can be determined. In this case the carrier oscillator was adjusted to bring it to the required accuracy. The reference signal was received via wire-line in a way that would not involve modulation, as used by a carrier system, as the inaccuracy of its mixing oscillators would impart inaccuracy onto the reference signal.

Several other instruments made up the complement of the Engineering Lab in Calgary. Some were for calibration purposes such as the CW3 war surplus receiver, used for WWV



Engineering Lab: 4th flr. Calgary — 6th Ave.: "Gib" Gibbard. (1957)

pickup. Others were for a more special use, like the zero center millivoltmeter employed for electrolysis measurements. Then there were various radio sets modified for survey purposes. AC recorders also became a much-used instrument ... we had several of these monsters.



Engineering Lab: 4th flr. Calgary — 6th Ave.: Jack Mulligan, "Gib" Gibbard.

Two Wandel Goltermann selective voltmeters were added in 1958. These were the first of the modern, high quality instruments. Performance was in keeping with the quality ... they set the standard for much of A.G.T. instrumentation of the future.

After moving to Edmonton, we obtained a pair of Siemens Audio sweep oscillators with a built-in cathode ray display. These were fantastic sets that greatly simplified voice frequency measurements of all kinds. The sets have given hundreds of hours of use without even an instance of trouble.

The sweep method has certainly saved much time and allowed an accurate and realistic picture

of results right at the time of adjustment.

I must mention that several years before, Gib described this same sweep method. He suggested that an oscillator be built that would slowly sweep across its frequency range and that a cathode ray display be synchronized to this, thus making the display stand still. I carried out a great deal of experimentation at home to try to accomplish this, and achieved a good deal of success, but time never seemed to allow refining the technique.

Gib was a strong advocate for sweep testing, pointing out its many advantages. He was most progressive in his ideas regarding instrumentation and encouraged much discussion of ways and means to carry out telephone tests. He was also instrumental in procuring various pieces of test equipment for the lab, for example: a set of DC voltage reference cells, R, C and L standards; the B and K acoustic measuring equipment for measuring the transmission characteristics of telephone sets (later used by Bob Taylor for Quality Assurance testing). Today, approximately 300,000 sets received annually (new and repaired) are sample-tested to determine batch quality. Gib also arranged to have a screened room built as part of the lab for an RF free area for the more serious radio tests. It also had a degree of acoustic isolation.

He also sent me to the IEEE instrument convention in New York on a number of occasions to gather information on instruments, testing procedures and the like. (I was in charge of the lab from 1956 to 1973). The information I gathered at the New York show (some 80 pounds of it) forms the basis of the large number of catalogues, brochures and technical information presently in the lab.

In 1951, Art built and demonstrated an instrument that he designed and constructed in his basement workshop. It functioned on the radar principle, and electrically measured the distance along a transmission line to an impedance irregularity. This could, for instance, be a missing load-coil or excessive capacity build-out on a loaded cable pair. The set was never 'prettied up' but the prototype proved very successful. Instruments of this type are commonplace now. It certainly shows the advanced thinking of the minds of people like Art and Gib, trying to keep abreast of measurement times.

Art was always building electronic gadgets. He had quite a collection of test gear at home, and was skilled in nearly every technical area, especially those where the electron meandered

idly by. His hobbies included operating his metal lathe, pheasant hunting, trailering, keeping his home built freezer working and candy making.

In 1957, I built a device for generating audio frequency signals to allow quick frequency tests on a cable. It was a dialable unit that once started would send signal after signal, each of a different frequency, in the range of 250 to 3000 cycles. Each burst lasted 5 seconds. The switching was done with relays under control of timing circuits; it incorporated an audio oscillator to generate the tones. The little gadget worked very well and was used to make runs on cable and trunk circuits.

Nowadays we employ many fancy instruments that are capable of measurement to the accuracy of a small piece of spider whisker. There is every conceivable instrument, but some still employ the old D'Arsonval meter. However, the trend is to digital readout using LED's, liquid crystals, and various numerical indicating devices. These work with all solid-state electronic circuitry using integrated circuits (IC's) no bigger than an aspirin. Each contains dozens of transistors and electrical components. These parts are in turn mounted on printed circuit boards that are manufactured in a manner akin to etching 'type' for printing. One thing's for sure: we've finally got rid of the bulky, heavy, unwieldy oak boxes of days gone by.

Another trend is to incorporate test equipment right into large telephone switching machines and the like. These, complete with print out, pin point troubles at the very time the message is carried. This makes fast accurate trouble shooting.



California: Martin Berger on Hewlett-Packard instrument course. (1963)

The Engineering Lab has now been shaped into a modern 'organization of instrumentation' to back up all this. Martin Berger guided the technical part of the operation --- a super craftsman with wide knowledge of instruments.

The lab now includes, as mentioned, instruments for DC standards traceable to the National Bureau of Standards. For instance, there is frequency calibration using a VLF (very low frequency) receiver that receives a 60 kiloHertz signal from Boulder, Colorado with an accuracy of at least 1 part in a million-million. This signal virtually crawls along the surface of the earth to a loop antenna hung on the wall of the engineering lab. The signal thus avoids the phenomena of Doppler Shift which causes frequency error, as would be the case if transmission was by way of ionosphere reflected short wave signal. Some instruments make it possible to measure sound as the human ear hears a telephone signal, through an artificial ear. Other test boxes measure the video signal for television --- a pulse that can stand no distortion and must be frozen in its tracks by a storage oscilloscope so that microscopic inspection of its electrical idiosyncrasies can be made.

Many test equipment manufacturing companies have sprung up and have stayed close to the communication companies, studying their needs and designing equipment specially for the case in point. One of these is the Hewlett Packard Company of Palo Alto, California. From a meagre two-man operation that supplied audio oscillators for the Walt Disney studios to provide sound effects for the show 'Fantasia', the company has grown into the present giant of instrumentation manufacture. AGT employs many of their modern microwave link analysers (MLA's) and a host of other assorted instruments. The MLA has practically revolutionized standard microwave radio testing, allowing several key measurements to be made, all with the one box.

Another company that has had a marked effect on telephone (radio) testing is Marconi. This company has been the stalwart in noise loading. This type of testing quickly evaluates the quality, design and adjustment of heavy route radio and multiplex systems. The application of a broad band noise signal (white noise) loads the system to its full extent. The input is slotted so that no signal is applied within the slot extremes. Measurement is then made within this slot at the receiver. Any anomaly will create an interfering signal here; it is a measure of this that

determines the system performance.

Yes, telephone test equipment has come a long way from the massive boxes for the lowly one channel 'G's' and 'H's' to the 'C's', 45's, '0's', 'N's', the 'J' and the 'L' (which incidentally long ago set the frequency plan for heavy route multiplex --- even for years to come). Radio too has seen great change, from the simple apparatus associated with the Olds/Sundre radio link in 1949 to the microwave of today with its travelling wave tubes, and exotic solid state devices that allow R.F. generation up to approximately 15 GHz.

As mentioned, the Engineering Lab has been the back-up for all this --- all of which started through the efforts of Art and Gib and Bob, such that a well-selected collection of instruments now exists.

Art early saw the need for such things as frequency calibration and he obtained what was on hand: a war surplus C3 receiver. He used this to pick up WWV on 15 mHz, then applied this modulated tone (400 Hz) to check the calibration of various oscillators and carrier signals. He also made arrangements to haul in a 4 kHz signal from New York by land line (non-carrier circuit). This signal was used to calibrate the 'J' and 'L' carrier master oscillators and other signal generators throughout the office. I was always intrigued with the way the 'J' carrier generated its signals for carriers and pilots. Keep in mind that these had to be all locked together. It used a saturating transformer in its basic 4 kHz frequency supply --- of course, a transformer operating in this way produces one gosh awful output loaded with harmonics, but this is exactly what is needed: a source that has many related signals to drive the respective channel oscillators.

The present telephone apparatus has certainly changed. Now it requires measurement and adjustment out of the range of the old boxes, present day measurements of the precision and magnitude required to put a man on the moon. Technology has taken off like an uncaged ball of rattlesnakes --- equipment now places 1500 channels in a tenth the space of days gone by, or, allows 'one hop' communication across the continent using a tiny ball of electronic intelligence floating beyond the clouds, that we call Anik. Equipment that incorporates thousands of miniature components is on a piece of substrate no larger than a postage stamp. Yes, equipment has certainly changed ... but our ways to test it have kept pace.

*Rivers and a
Few Fishing Yarns*

I JUST must include this chapter!

Rivers have always fascinated me — I marvel at the prehistoric sculpture that carved the canyons and waterways, and too, the wild life that abounds in this environment. During my travels I have often stopped nearby and absorbed this grandeur.

I remember once travelling to Peace River, arriving there at about 7 in the evening. I had a bite to eat, then drove into the country to spend an hour or two.

Heading south along a trail on a hog-back towards the hamlet of Nampa — a narrow ridge that allows a view to either side, I stopped and sucked in the stillness of a sprawling landscape. There are two big rivers on the right, with another in the canyon to the left. It seems here as if the Smoky and Peace had embarked on marital bliss and joined together, then are greeted by the smaller but more picturesque Heart. To the east of the ridge (the Heart Valley) is a sanctuary for bird and animal where, if you

have a pair of Bushnells handy, you may see deer, or moose, or coyote far below. This spot deserves a stop to take in the exciting beauty of the canyon and watershed; the rivers joining at a place, as though planned as a setting for city or town. It is indeed close by that the town of Peace River settles into this scenic location. As a matter of interest, near this same place (just north of the railway bridge) is a crevice in the rock from which gas seepage feeds a flare that has burned for a decade or more.

The Peace River has numerous memories for me. It is different in many ways. It is mighty, yet assumes a quiet, peaceful attitude as it slips past the town and where 400 foot banks guide it on its way to the Arctic.

Once Art Davis and I, on a weekend stay at Grande Prairie, were offered a sight seeing trip up the river in a small boat. It started west of Fairview. 'Putting' our way upstream for three or more hours, we finally turned and drifted back with the current. The massive shale banks serenely slipped by, shadowing many trusting animals that came to drink at the shore.

This was a trip I'll remember always. Just to see the great flocks of snow geese on the gravel bars, having come from the wheat fields, now picking up the much-needed grit and drinking from the river. They resembled huge moving snow banks — it wasn't until we'd passed within a football's throw that they soared into a thunderous cloud.

I talked to Les Smith, the Manager of the Grande Prairie Office, about our trip and he related similar experiences. He said he often took a canoe up the Wapiti River, then drifted lazily down with the current. He said that he'd photographed the eyelashes of moose and other animals that had come to drink, or were just 'moseying' along the bank. He said he could float right by their noses without a flick of suspicion. Surely, this is more a thrill than the set of still and lifeless antlers secured on the top of a car — the prize of a high-powered rifle.

Another time Art and I (in the freeze of winter 1950) walked down the ice-covered Peace. Stopping on several occasions to peer through the large holes made by the ice cutters, we viewed the fast moving current and numerous submarine sized jack fish cruising below.

Several miles upstream from the town of Peace River and south of the town of Fairview (Fairview used to be named Waterhole) is a wide, placid expanse of river used over many years as a point of crossing, called Dunvegan. This area,

steeped in history, has several ancient buildings on its banks, a reminder of the colorful blunderbuss and arrowhead days of yesteryear. It was used until about 1965 as the place for a ferry crossing. Now a modern steel bridge handles the traffic. Once when I crossed by ferry, the helmsman related that one time, mid-stream, the anchor cable broke. The ferry bobbed downstream for ten miles or so, and finally hung up, somewhat askew, on a gravel bar. Many anxious, white-knuckled passengers were greatly relieved when it came to this precarious stop. They spent three hours of uncertainty awaiting rescue.

I crossed the River sometime later, just north of Boyer River at Tompkins Landing — a beautiful spot where another ferry quietly slips across a three-quarter mile stretch. A river that has seen history unravel — from sourdough to farmer and magneto telephone to microwave.

Other rivers of my telephone travels were the Saskatchewan, Bow, Elbow, Old Man, Castle, Smoky, Athabasca, MacLeod and Red Deer. It is with inward satisfaction that I have had the experience of viewing these rivers that etched Alberta's water shed, most of which started from a meagre snow-fed trickle deep in the Rockies.

While early morning fishing, I have watched beavers hauling branches to build their dam on the Red Deer. Then, in the evenings at Drumheller, I have wandered the cactus-studded banks of prehistory, often to find fossilized wood or bone or clam shell (or an old horse shoe).

The Red Deer valley is my favorite. Here as a boy I became so familiar with the coulees and ravines that wander down through its steep banks to the river bottom — always a boys' favorite for a day's exploration.

Since those times I have cast a fishing lure into most of these rivers nearly always returning with a trout or white-fish.

Like most fisherman, I have fishing tales — a yarn or two of beating our way along Willow Creek while working at Exshaw ... of fishing Bassano dam while on the 'J' station job. Vaughan Monson was with me. He pulled in an ancient old char as big as a gum boot.

Once Steve Nicol and I travelled to the Beaver Dam creek just north of Cochrane. As we walked along the bank, Steve spotted a big rainbow trout sleeping in the sun.

"Gimme your knife," he motioned.

I pulled my hunting knife from its sheath and handed it to him. He took aim . . . then in a flash, made a dive at the fish. A water spout

erupted. When things calmed, there was Steve, submerged to his armpits with both arms wrapped around an unhappy snapping fish.

We never did find the knife, but Steve will likely go down in the annals as the only person who ever snuck up on a sleeping rainbow and ended up with it in the creel.

Once while working at Red Deer, I travelled to a popular stream west of town for a bit of early morning fishing. There were many beaver dams, so likely spots for good sized fish. I baited up and was about to toss an overhand cast into the water. I stopped short, as out of the corner of my eye I saw a slinking form ... I couldn't believe my eyes. It was Don Lynch, foreman of the Installation crew (and in my estimation one of the best fishermen in AGT).

I watched. He quietly slithered along on his stomach ... on reaching the edge of the dam, looped a lure up and over. Waiting a minute or two, he finally twitched the line to simulate life into the hunk of brass.

An explosion echoed, he was hooked to a whopper. I learned a lesson right there ... to be a successful fisherman you must be willing to come home with a wet belly and burrs in your socks.

When fishing Lost Creek near Exshaw, I tramped along in a stream tying a buck tail on my line. All of a sudden, I dropped to my chin in a beaver run. Those pesky beavers cut out the darndest channels for freighting their logs.

One sunny Saturday a gang of telephone guys headed for Kananaskis to deplete the fish population to the tune of a dozen or two. Jim Barnes, Jack Mulligan and a couple of others were there. (I was not, but I got a vivid account from Barnes). Jack, for the fun of it, put a hook through a small red radish accompanied by a willow leaf lure. He tossed it out into the deep, then sat eating a sandwich. Suddenly, a furious swirl indicated that a big fish had decided on fresh radish for lunch.

Here is a tale, not exactly a fish story, but, somewhat related. It happened at Kananaskis. Bill Jamieson, Doug Lawrie, Vaughan and a couple of other guys were along. I baited up and soon had three pan-sized trout in my creel, so feeling satisfied, I started off for a walk into the woods. It was marshy ... I slurped along in my waders. In the depths of the forest I was alerted by a strange clucking sound ... when I looked up I saw a big owl sitting on a branch about forty feet away, glaring at me. It moved from foot to foot, flexed its wings and kept uttering strange

owl talk ... I suppose words that cursed me for waking it from its nap. It cooed and clucked away to beat the band. In return, I answered in a similar "whoo! whoo!" The owl, too inquisitive to fly, came back with "whoo-who-who". A dialogue of this nature went on for some time. The owl matched my every whoo-who - it kept moving from foot to foot but seemed magnetized to the branch. Suddenly I reached up and grabbed it by the legs. Instantly I was part of an exploding ball of fury, 'eyeball to eyeball' and 'nose to beak'. I stood shaking, not knowing what to do - the big bird was now screeching sounds of owl profanity in a predicament it had never experienced. I hung on with a death grip — if this big bird thought it would shake me off, it had another think coming, as I, a catcher of birds by hypnotic confrontation, would hold on until the hot coals of Hades fizzled out. It wasn't long before 'Screechie' had my jacket in shreds and there were welts on my shoulders. I started back to the trout stream.

Each step echoed slurpy gum boot slups as I high stepped my way through the marsh.

I approached the guys with my flapping bird high over my head shouting, "Me Son of Shokima — Father of Great White Bird ! Me keep you safe while tramping the woods — me keep your hook sharp and let you know when warden approach — me bring you luck when trying to catch wily Brown Trout and great Dolly Varden". At the end of each phrase the owl let out a squawk and beat its wings.

Finally I released the bird. Too surprised to believe it, it fluttered to a stump then gave me a final glare. It muttered something then spread its wings and flew into the forest, obviously with tales for owlets of a strange creature that talked like an owl and enticed owls to its grip and, if they ever encountered it, to fly off as fast as they could.

There are numerous other tales, such as the time Vaughan and I went up the Beaver Dam Creek only to be caught in a flash flood. When we tried to cross the creek, his old Ford dropped, clean out of sight between the boulders. Water poured in one door and out the other. I jumped out to try and pull the rocks away from the wheels but forgot in the excitement that I only had one wader on.

Then there was the time I got lost in the willows, because I'd followed a deer trail into the thicket to take a shortcut only to find it petered out ... for a long time I was truly lost, soaking wet and scared stiff.

FROM
PHANTOM
TO FIBRE



Another time, Vaughan and I were finishing off some 'O' carrier open wire testing between Exshaw and Banff. We stayed in Banff. Now Banff, being in the heart of the best trout fishing in the world, beckoned us to get up early and go fishing for an hour or two before work (and even an hour or two after supper). Our favorite spot was the Vermilion Lakes just west of Banff. We used to go there and thrash the waters with a spinning rod, with mediocre success.

It so happened that one of the Chefs from the Banff Springs Hotel appeared on site, out for a morning stroll. Arriving at the place where we were fishing, he stopped for a few minutes.

"No! No! No!" he said, "You scare all the fish away that way, here's what you do! See that beeg lily pad out there — tie on a beeg 'bucktail' fly, then flip it out on top of it. Then sit down an' light up a cigarette. After you've smoked it

then gently edge the bucktail off and skitter it across the water. Just as sure as anyting a beeg trout that's lying underneath will come out an' grab the fly."

Well, I tried just this. I baited up the four pound monofilament with a big hairy buck tail, flipped it out on the pad, then sat down and lit up a cigarette. After smoking it, I gently eased the lure into the water. A swirl and a huge splash occurred — I had hooked a good sized fish.

After this, I repeated the procedure many times, always with a high degree of success.

I have fished many streams around Banff, always catching a pair of trout on the outing but always remembering my short association with the Chef from the Banff Springs Hotel.

These tales could go on and on but I must draw the line. It was all part of telephone travel along with a few leisurely hours.

Conclusion

THUS concludes my chronicle of telephone ramblings, of events and happenings over a period of time that embraced vivid changes in communication. This era bridged the chasm between Vacuum Tube and Transistor, saw the birth of continent-wide communication by satellite, and the coming of television with its true-to-life color, and the commonplace use of complicated electronic switching systems that 'lets the finger do the dialing' almost instantly to distant places. In July, 1975, British Columbia announced that it was the first province in Canada to go DDD on an overseas basis. This era has also set the stage for large DATA networks that someday will likely have more 'black boxes' talking to other 'black boxes' than 'people talking to people'.

Indeed, technology has embarked in a sky-clawing direction. Much has lain dormant in the labs of science, now emerging to infect industry with a contagious race for development. Just think, telephone research deserves much credit for this. The very birth of the transistor was in telephone labs (in 1948) and, of course, Canada

claims fame for launching basic telephone principles through Alexander Graham Bell at Brantford, Ontario in 1875. In more modern times, take the exciting concept of PCM (Pulse Code Modulation) thought up by a man named Keeves in 1937. AGT is now using this equipment for both toll and exchange circuits - the first toll system having been commissioned for service July 1974. This is a 24-channel Lenkurt PCM carrier working on underground cable on the route from Stettler to Altario, near the Saskatchewan border. It serves towns along the way with clarity of hearing that is hard to believe.

And now, as if to save the best to the last, is the employ of a strand of glass to transport the communication signal via a beam of light. This is a wonderful breakthrough in scientific achievement made possible by the supporting family of solid state devices, brought about by the star of communication, the transistor, launched in 1948. The use of this technology has swung wide the gate of implementation in uses that cannot even, in this day, be dreamed of.

It is thus, with appreciation, that I had the opportunity to take part in this interesting electronic era. It started for me some 50 years ago when the thrill was that of tapping out a Morse Code signal to some distant radio station; now I take part in the giant operation of world wide communication. I will always thrill to my world wide contacts by Amateur Radio, and lately, I

can even see people as I talk to them around the world, by way of Amateur Slow Scan Television, a thrill that has few equals. To date, this has been achieved to no less than 10 countries in 2-way fashion.

Telephone work and my hobby are related ... when retirement comes, telephone work will be traded for more involved Amateur Radio activity. Of course when radio becomes tiresome, there will always be the lure of the trout stream ... a temptation impossible to resist.

Conclusion



Red Deer Cutover: (clockwise from left), (unidentified), Al Fearey, Jim McDonald, Jack Segstro, Bob Roseneder (Cutover Chairman), Jack Childs (standing), Len Elder, Evan Addy, Bill Andrews, "Gib" Gibbard, and unidentified member. (1961)

E p i l o g u e

THE SCIENTIFIC world has literally been set into a tail spin over the last decade, largely because of the growth and development in the electric field.

Every endeavor surrounding us has been affected. One of the important things that has brought this about is the new manufacturing process, miniaturizing electronic components used for making microprocessors and the like. Made from integrated circuits, many tiny components are packed onto a single piece of substrate, which in turn become the heart of a computer — and we all know the story about this. This has almost solely revolutionized communications. Here then are a couple of others, for instance, that technologists have dumped in our laps to ponder.

AURORA — Mobile Radio Network

This is a 450 MHz radio network established throughout the province to allow continuous mobile telephone service to a vehicle as it travels

from point to point. A telephone call is set up between the telephone-equipped car and a telephone at a fixed location.

For this, the province has been divided into zones, each with a degree of overlap. As the vehicle travels along a route, still in contact with the other phone, it progressively goes from zone to zone. However, in this case, a computer monitors and switches the signal when levels begin to fade. This effectively creates a constant level and will make the circuit appear to be continuous. A great deal of new technology, new apparatus, and field testing has been necessary to make this possible. It is certainly a far-reaching and different approach to telephone use.

Fibre Optics

Fibre Optics is a relatively new technology introduced into the communication field some ten years ago. It showed high promise of filling a need for a better way to transport voice frequency and high frequency signals over long distances without using copper wire. This method offers a clean path, unaffected by electromagnetic disturbance, and is now used for the most exotic applications. Today, it indicates that the sky's the limit for future uses.

One of the most striking advancements has been in the bit rate handling capacity, which has climbed in the last decade from about 2,000 voice frequency channels (each 3000 Hz wide) carried on a single strand of glass fibre, to about 12,000. This is usually expressed in terms of megabits of pulse transmission, because almost all signals are pulse code modulated.

This is illustrated by the following: the old entrance link from Cheadle to Calgary, a distance of about 65 Km, was equipped with fibre in about 1980. It handled an equivalent of 4032 V.F. channels. Compare this to the system, presently in the design stage, to replace it: it will handle an equivalent 8,074 V.F. channels.

The old system required 15 HF repeaters. Today's system will not likely require any repeaters. This results in many advantages, namely lower signal distortion and jitter.

DC power to repeater points will not be necessary; maintenance and over-all costs will be lower. A cable, using single mode light transmission plowed to a depth of 5 feet under ground will bring the high frequency multiplexed channels to terminate at Cheadle in to the Calgary Toll Building.

Satellite

Canada launched Alouette in 1962, Anik A in 1972 and Anik D in 1982. This was the start of Canada's contribution to space involvement to create world-wide communication coverage. Satellites in stationary orbit at heights of some 38,000 km above the earth transmit signals to and from earth stations. This has revolutionized communications for voice and television, as well providing weather pictures and other information.

I am a Radio Amateur, and was operating the day after the Edmonton Tornado (July 31, 1987). I was in contact by radio with another amateur in Brisbane, Australia. I asked him if he had heard about the tornado here, and his reply was that he had just seen it on the evening TV news. Within hours of chatting with him I swung my beam antenna to the north and happened to contact another operator, this time in Helsinki, Finland. I also asked him if he had heard about the bad storm here. He also answered, "Yes, I just saw it on the news on TV." In both cases, TV pictures were transmitted by satellite. To return to the computer for a moment, a recent news account placed part of the blame for the "Black Monday" (October 19, 1987) stock market crash on the manipulation of the market by brokers using computers. Stocks were being bought and sold by computers programmed to buy and sell automatically.

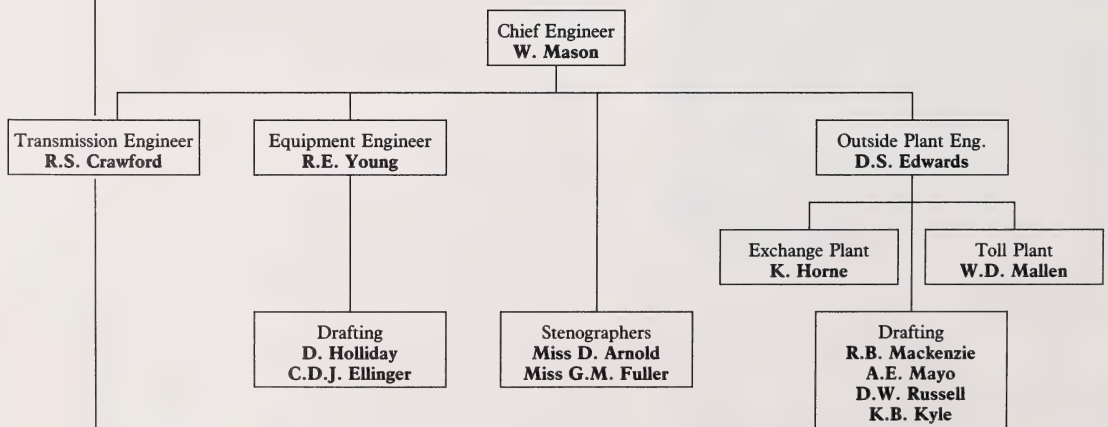
Ah yes! **BLACK BOXES** talking to **BLACK BOXES**.

January 15, 1988
Edmonton, Alberta

O r g a n i z a t i o n a l C h a r t s

Alberta Government Telephones

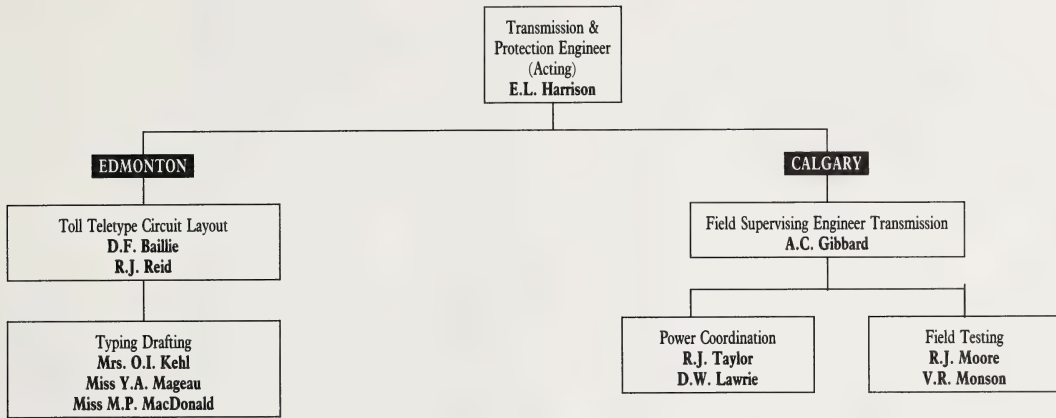
Engineering Department
Organization Chart
January 1, 1946



Alberta Government Telephones

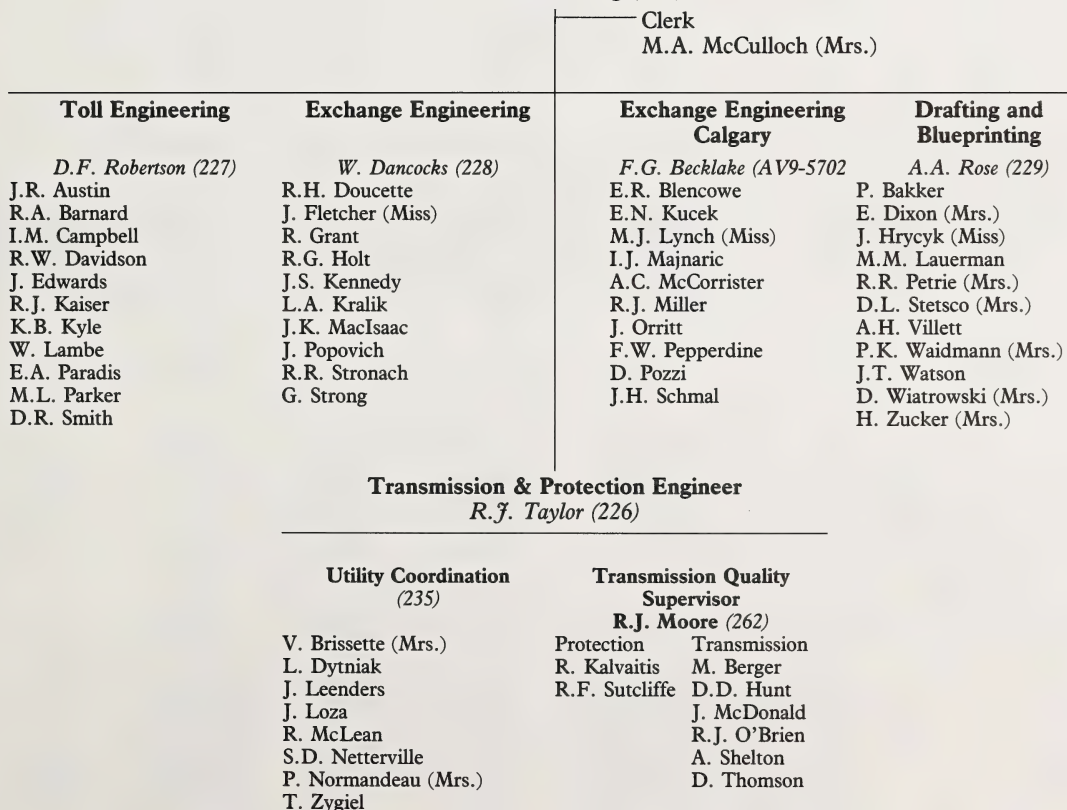
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Organizational
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Alberta Government Telephones

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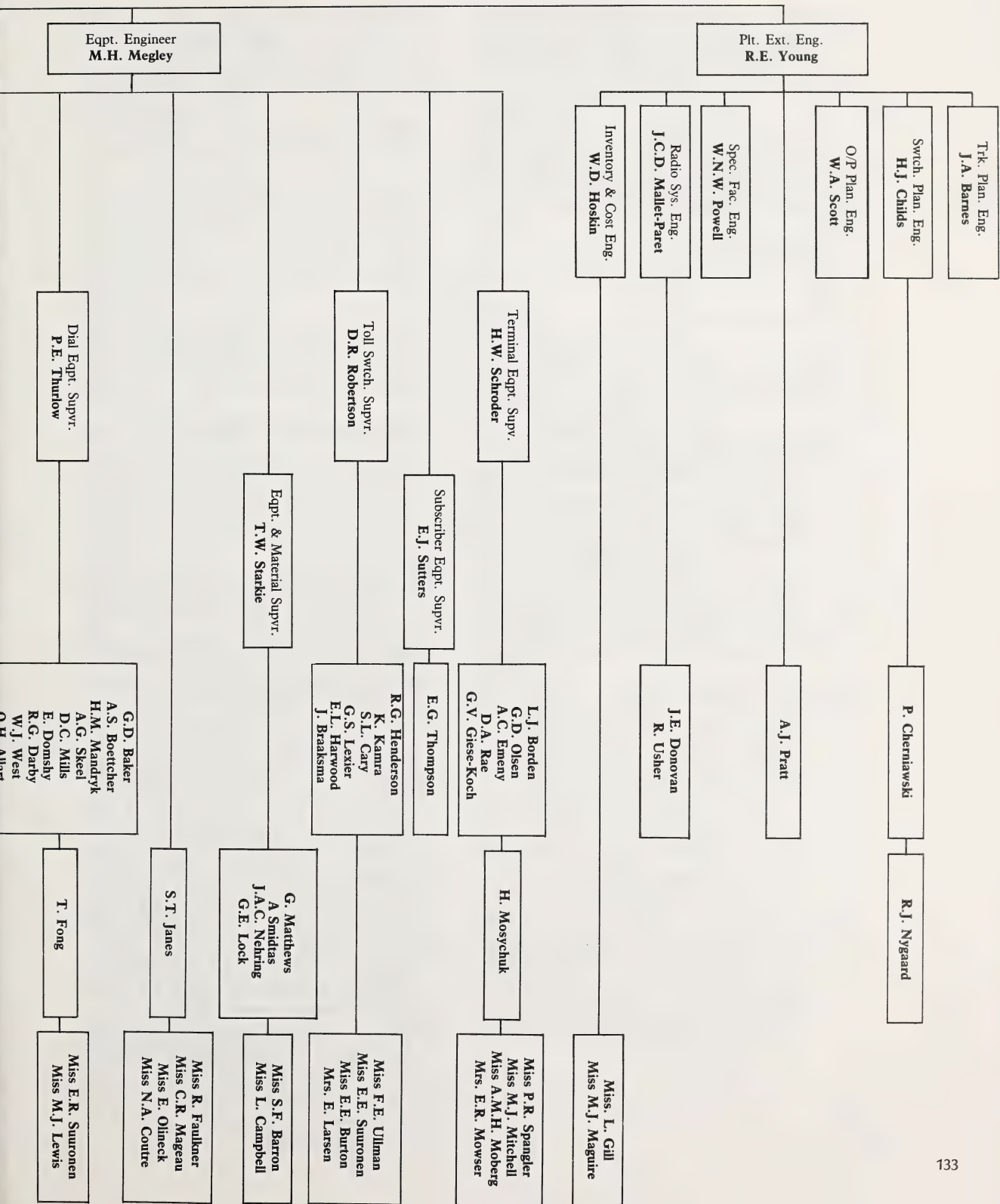
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Miss V. Senti

Staff Engineer
D.S. Edwards

Mrs. D.V. Deeproose
(Née Ford)

Engineering Department Organization Chart July 1, 1955



Glossary of Terms

AC — Alternating electrical current generated by an alternating voltage swinging from positive to negative polarity.

BRACKETS — Fastened to the crossarms to support them, or the insulators to in turn, support the long telephone wires.

BRIDGE — used when referring to the “Wheatstone Bridge” (which see).

CAPACITORS — An electrical circuit component that can be used to store electricity.

CARRIER — A term referring to apparatus with which a number of circuits can be grouped together to be transmitted or carried by a common high frequency signal.

CATHODE RAY TUBE — **CRT** — A vacuum tube with a glass screen allowing a picture to be placed on the front — see your T.V. set

CLIMBING IRONS — A common name given to spurs that are fastened onto a lineman’s legs to allow climbing a wooden pole.

CYCLE — describes the frequency of A.C. voltage. Today, ‘Hertz’ (Hz) is favoured.

DOPPLER SHIFT — Caused by the change in the point of reflection of a signal bounced off the ionosphere appearing as a change of frequency on the ground.

FIBRE — This refers to a strand of glass fibre used to carry a voice signal.

FIBRE OPTICS — A general term referring to transmission of signals by way of a light beam through glass fibres.

HEAVY GANG — The crew of men assigned to do heavy construction, usually of telephone lines.

JACK STRAPS — These are leather straps that have a clamping device to readily attach to an open wire in each direction, allowing manual pulling of the ends together to in turn, attach nicopress sleeves or to make a twisted connection.

KLYSTRON — A vacuum tube used for generating or amplifying ultra high radio frequencies. Usually a low power device — however Klystrons can be made to handle as much as 50 KW of power.

LIGHTHOUSE TUBE — a small UHF triode.

MAGNETO TELEPHONE SETS — The common name given to telephone sets of old, which used a magneto, and was cranked by hand to produce a voltage to ring bells of a distant telephone set or switchboard.

MAGNETRON — A vacuum tube made to handle very high microwave signals usually of the pulsed variety.

MHz — MegaHertz (a million Hertz) is the new term used for A.C. signals in the radio spectrum.

MICROWAVE — A term referring to the ultra short wave length of the radio waves using dish-type antennas on towers.

MURRAY — A bridge connection that is often used to measure the distance to open circuits. A low frequency A.C. signal is used instead of D.C. on the bridge.

NECo — Northern Electric Company, now Northern Telecom Canada Ltd.

98A PROTECTOR — A piece of electrical equipment used for protecting telephone equipment against extraneous voltages and current. It gives protection against voltages in the 350 to 700 volt range, and currents of about 25 amps.

PABX — Private Automatic Branch Exchange — calls switched without an operator's help.

PBX — Private Branch Exchange — operator handles all equipment.

PHANTOM — A method of connecting open wire, whereby another circuit was obtained from 2 existing pair of wires on an open wire line.

REPEATER — This device amplifies a telephone signal (in each direction) along the telephone line.

SLOW SCAN TELEVISION — A narrow band system for transmitting video (250 Hz to 3000Hz) The picture rate is approximately 1 picture per 6 seconds. Some form of storage is required.

STYLE "B" — The name given to the wires that attach the telephone cable in the lane to the house.

SUB SET — A common abbreviation, referring to a subscriber telephone

SUB CYCLE RINGER — a piece of electrical equipment that converts 60 Hz mains frequency to 20 Hz for ringing bells, etc.

SUBSTATION — Refers to a place in the electrical power system where voltages are changed and routed for use in the network.

TRANSMISSION — A general term relating to the sending of telephone signals along a facility, usually referring to the quality of a signal from the standpoint of hearing.

TRAVELLING WAVE TUBE — TWT — A microwave tube that can tune over a very wide range of frequencies — a high gain device made in the power range of a few milliwatts to 10 W (approx.).

TRANSISTOR — the name given to a device that takes the place of a vacuum tube for obtaining amplification and similar electrical uses.

TURNER VALLEY RAW TRACTOR GAS — a reference to very volatile petroleum coming out of oil wells in the Turner Valley fields.

1260 — The common name given to a magneto switchboard (used extensively in the past).

VF — Describes A.C. signals of a voice frequency range (usually 250 to 3000 Hz).

VARLEY — A method of connecting a Wheatstone Bridge to allow measurement of a grounded wire or a cross with another wire.

WHEATSTONE BRIDGE — The test device used to measure D.C. line troubles, named after the inventor of the principle.

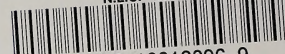
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